भारतीय मानक
Indian Standard

IS 3224 : 2021

द्रवित पेट्रोलियम गैस (एलपीजी) सिलिंडरों को छोड़कर संपीडित गैस सिलिंडरों के लिए वाल्व — विशिष्टि

(चौथा पुनरीक्षण)

Valve for Compressed Gas Cylinders Excluding Liquefied Petroleum Gas (LPG) Cylinders — Specification

(Fourth Revision)

ICS 23.020.30, 23.060.01

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Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards on recommendation of the Gas Cylinders Sectional Committee, had been approved by the Mechanical Engineering Divisional Council.

This standard was first published in 1966 and revised in 1971, 1979 and 2002. In this revision the following major changes have been made:

a) Classification, description and testing of different type of cylinder valves based on operating mechanism;
b) Endurance test, flame impingement test, excessive torque test and valve burst pressure test added as type test; and
c) Separate section added for production inspection and testing.

This standard was originally based on BS 341 Part 1 'Valve fitting for compressed gas cylinders'. The fourth revision of this Indian Standard has been necessitated to incorporate amendments and to align the tests with ISO 10297 : 2014 'Gas cylinders — Cylinder valves — Specification and type testing' and also as a result of experience gained by the industry and consumer over the year.

Compressed gases supplied in cylinders are diverse in their chemical composition and properties. Some are oxidizers, some are flammables, some are inert, etc. Gases vary in degree of corrosiveness, toxicity and exist not only in pure state but also in variety of mixtures. Thus it becomes a primary safety requirement of the cylinder valve that it must be appropriate for the intended use. The intended use must be identified and the cylinder valve must incorporate proper pressure capacity as well as functional reliability for safe operation.

Manufacture, possession and use of any gas contained in cylinders in compressed or liquefied state is regulated under the *Gas Cylinder Rules, 2016* of the Government of India as amended from time to time. This standard has been prepared in consultation and agreement with the statutory authorities under those rules.

Other standards for valve fitting are:

a) IS 7302 : 2018 Valve fittings for self-contained breathing apparatus (SCBA) and self-contained underwater breathing apparatus (SCUBA) — Specification (*first revision*).
b) IS 8737 : 2017 Valve fittings for use with liquefied petroleum gas (LPG) cylinders for more than 5 litre water capacity — Specification (*second revision*).
c) IS 8776 : 1988 Specification for valve fittings for use with liquefied petroleum gas (LPG) cylinder up to and including 5 litre water capacity (*first revision*).
d) IS 12300 : 1988 Valve fittings for refrigerant cylinders — Specification;
e) IS 16988 : 2018 Compressed Natural Gas cylinder valve integrated with solenoid operation (remotely controlled) for automotive use — Specification.
f) IS 3745 : 2006 Yoke type valve connection for small medical gas cylinders — Specification (*second revision*).

The general machining tolerances unless otherwise stated shall be medium class specified in IS 2102 (Part l) : 1993 'General tolerances: Part 1 Tolerances for linear and angular dimensions without individual tolerance indications (*third revision*)'.

The relevant SI units and corresponding conversion factors are given below for guidance:

$$1 \text{ kgf/cm}^2 = 98.066\,5 \text{ kPa (kilopascal)} = 10 \text{ m of Water column (WC)}$$
$$= 0.098\,066\,5 \text{ MPa (megapascal)}$$
$$= 0.980\,665 \text{ bar}$$
$$1 \text{ Pa} = 1 \text{ N/m}^2$$

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

VALVE FOR COMPRESSED GAS CYLINDERS EXCLUDING LIQUEFIED PETROLEUM GAS (LPG) CYLINDERS — SPECIFICATION

(Fourth Revision)

1 SCOPE

1.1 General

This standard covers the requirements for design, materials, manufacture and testing of new valve fittings for use with refillable aluminum and steel cylinders for compressed gases (permanent and high and low pressure liquefiable and dissolved gases) other than liquefied petroleum gas (LPG) up to 1 000 litre water capacity. The standard also covers valve fittings for use in firefighting and for compressed natural gas cylinders for automotive use.

1.2 This standard gives the details of the dimensions of inlet taper threads and outlet of the valves so as to ensure interchangeability. Detailed dimensions of the internals and construction of the valves is not given in this standard. Such details shall be as agreed to between the purchaser and the manufacturer.

1.3 Exclusions

This standard does not cover valves for breathing equipment, self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA), cryogenic equipment, valves for small refrigerant cylinders and residual pressure valves (RPVs), Solenoid operated cylinder valves and LPG valves. Pin index type valves for medical cylinder.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7241 and the following shall apply.

3.1 Ageing — A change in a metal by which its structure recovers from an unstable condition produced by quenching or cold working.

3.2 Bottom Spindle (also Known as 'Seat Insert Holder/Seat Plug/Lower Plug) — Lower member of a two-piece spindle actuated by the top spindle.

3.3 Bursting Disc (Rupture Disc) — An operating part of a safety device in the form of a disc, usually of metal and which is so held as to close the safety device channel under normal conditions. The disc is intended to burst at a predetermined pressure to permit the escape of gas.

3.4 Burst Test Pressure (P_{vbt}) — Minimum pressure applied to a valve during hydraulic burst pressure test.

3.5 Combination Bursting Disc and Fusible Plug (Combination Relief Device) — A bursting disc in combination with a low melting point fusible plug intended to prevent the disc bursting at its predetermined bursting pressure unless the temperature is also high enough to cause yielding or melting of the fusible metal.

NOTE — Combination of fusible alloy and bursting disc are placed in series.

3.6 Cylinder Neck — The part of the cylinder that has the threaded connection for the valve stem (inlet).

3.7 Cylinder Valve — Mechanical device attached to a compressed gas cylinder that permits flow into or out of the cylinder when the device is in the open position and prevents flow when in the closed position.

3.8 Diaphragm(s) — Formed, flexible disk (s) clamped between the valve gland/bonnet and the ledge in the valve body in diaphragm-type valves that provide (s) a seal or pressure barrier between the wetted parts of the valve and the exterior.

3.9 Dip Tube (Siphon Tube) (also Known as 'Eductor Tube') — Tube fitted to the valve to allow withdrawal of liquefied gas without inversion of the cylinder/tube that is attached to the valve inlet to withdraw liquid from the cylinder.

3.10 Endurance Torque (T_e) — Closing torque applied during the endurance test.

3.11 Endurance Torque at Start ($T_{e,\ start}$) — Torque to be applied at the beginning of the endurance test to achieve leak tightness.

3.12 Endurance Torque at End ($T_{e,\ end}$) — Torque measured at the end of the endurance test to achieve leak tightness.

3.13 Excess Flow check Valve — Valve which automatically shuts off, or limits, the gas flow when the flow exceeds a set design value.

3.14 External Leak Tightness — Leak tightness to atmosphere (leakage in and/or leakage out) when the valve is open and the outlet is sealed.

3.15 Failure Torque (T_f) — Opening or closing torque (whichever is the lower value) applied to the valve operating device to obtain mechanical failure of the valve operating mechanism and/or valve operating device.

3.16 Filling Pressure — The settled pressure at a uniform temperature of 15 °C at full gas content.

3.17 Flow Rating Pressure — Inlet Pressure at which discharge capacity of PRD is measured.

3.18 Flow Restrictor — Device designed to limit the maximum flow through the valve outlet.

3.19 Free Air or Free Gas — Air or gas measured at a pressure of 1 atmosphere at 20 ° C.

NOTE — Pressure values given in this standard are given as gauge pressure (pressure exceeding atmospeheric pressure) unless noted otherwise.

3.20 Full Flow — Valve's open position when maximum flow capacity is achieved.

3.21 Fusible Plug (Thermally activated relief device) — An operating part in the form of plug filled with suitable fresh low melting point material, usually a metal alloy, which closes the safety device channel under normal conditions and is intended to yield or melt at a predetermined temperature to permit the escape of gas.

3.22 Gland Nut (also Known as 'Packing Nut' or 'Bonnet') — Threaded valve component tightened onto or into the valve body to retain and compress the packing, diaphragm(s) or other sealing member(s).

3.23 Hand Wheel — Manually operated device attached to the valve spindle used to open and close the valve.

3.24 Hand Wheel Diameter — Nominal value of twice the largest radius from the center of the hand wheel.

3.25 Internal Leak Tightness — Leak tightness across the valve seat (leakage in and/or leakage out), when the valve is closed.

3.26 Leak — An unintended flow of gas or liquid in excess of 6 cm^3/h corrected to NTP.

3.27 Minimum Closing Torque (T_c) — Torque necessary to be applied to a valve operating device (*see* **3.62**) of a newly manufactured valve to obtain internal leak tightness (*see* **3.25**) at valve test pressure (*see* **3.65**) and room temperature.

3.28 Normalizing — A process in which steel is heated to a temperature above its upper transformation temperature (known as solution temperature) and subsequently cooled in still air.

3.29 NTP — Normal temperature and pressure [20 °C (293.15 K), 1.013 bar absolute (0.1013 MPa absolute)].

3.30 O-ring — A torus, a circle of an elastomer, with circular cross section which effects a seal against pressure.

3.31 Outlet Dust Cap/Plug — Cap or plug that only serves as a protective covering for the valve outlet to minimize contamination from external sources and to minimize damage to outlet threads.

3.32 Outlet Seal Cap/Plug — Cap or plug that serves as a protective covering for the valve outlet against contamination from external sources and serves as a pressure barrier to prevent leakage through the valve outlet.

3.33 Oversized Valve — A valve having larger than normal stem thread to suit an oversized cylinder neck thread.

3.34 Operating Torque (T_o) — Opening or closing torque (whichever is the lower value) applied to valve operating device to determine the level of torque, which the valve operating mechanism can tolerate and remain operable.

3.35 Oxidizing Gas Service Valve — Valves used for oxygen, oxygen enriched gas mixtures (over 23.5 percent oxygen) or other highly oxidizing gases such as nitrous oxide.

NOTE — Valves used for air that has an oxygen concentration not greater than 23.5 percent by volume are not considered oxygen gas service valves.

3.36 Packing — Non-metallic material installed around the spindle in a packed valve that when compressed creates a seal against leakage past the spindle.

3.37 Packing gland (also known as 'Packing follower') — Ring, usually metal, often installed on top of the packing in a packed-type valve so the gland nut is not torqued directly against the packing.

3.38 Packing Ring — Ring installed in a packed-type valve to provide a suitable seat for the packing.

3.39 Pressure Relief Device (PRD) — Pressure and/or temperature activated device used to prevent

the pressure in a cylinder charged with gas from rising above a predetermined maximum pressure and/or temperature thereby preventing rupture of the cylinder.

3.40 Pressure Relief Nut — Rupture disc holder threaded into the valve body that incorporates a precisely machined edge around a relief device discharge port against which the disc is designed to rupture.

3.41 Pressure Relief Plug — Rupture disc holder threaded into the valve body that retains a rupture disc in place and incorporates a precisely machined edge around a relief device discharge port against which the disc is designed to rupture.

3.42 Pressure Relief Valve (PRV) — A safety device containing an operating part that is held normally in a position closing the safety device channel by spring force and is intended to open and to close at predetermined pressures.

3.43 Prototype Test (also Known as 'Design Qualification Test or Type Test) — A test or series of tests carried out for approval of a valve design to the requirements of the product specification.

3.44 Quenching — A process in which a material is heated to a temperature above its upper transformation temperature (known as solution temperature) and then quenched in a suitable medium.

3.45 Rated Bursting Pressure for Bursting Disc — The maximum pressure at which the bursting disc is designed to burst at the rated temperature when in contact with the pressure opening for which it was designed.

3.46 Rated Flow Capacity of PRD — The capacity of a pressure relief device measured in cubic metre per minute of free air at the required flow rating pressure at NTP.

3.47 Seat Insert — Material contained in or on the bottom spindle (sometimes on a one-piece spindle) usually made of a soft material to facilitate sealing against the valve body seat.

3.48 Shutoff (also Called 'Closure') — Position of the valve when the valve spindle is in contact with the valve body seat, no-flow condition of the valve.

3.49 Spindle — The element(s) of the valve which, when operated, directly or indirectly actuates the sealing member (seal) to 'open' or 'closed' position.

3.50 Start to Discharge Pressure — The pressure at which the first bubble from a tube of 2.5 mm inside diameter appears through water seal of not over 100 mm on the outlet of the pressure relief valve.

3.51 Stress Relieving — A process to reduce internal stresses in a metal/forging/component by heating it to a suitable temperature for a stipulated period of time.

3.52 Tang — Member or extension projecting from either the lower end of a top spindle or the upper end of a bottom spindle, mechanically attached or integral to the spindle, through which torque is transmitted in a two-piece spindle.

3.53 Thread Sealant — Material applied to a taper thread to effect a gas tight joint. It fills the cavity remaining in the helix of mating threads.

3.54 Thrust Bearing/Washer — Disk-like part sometimes inserted between the top spindle and the metal diaphragms to reduce friction.

3.55 Top Spindle — Upper member of a two-piece spindle that when operated causes the bottom spindle to move.

3.56 Valve Actuator — Manually or remotely operated device used to open and close the valve.

3.57 Valve Body — The major portion of the valve (normally single piece) that has been machined to have the inlet, the outlet, connections, and where applicable, a boss for pressure relief device. There are other machined areas to assemble other parts for operation of the valve and fitment of excess flow check valve, filter etc., to create a complete valve assembly.

3.58 Valve Body Seat/Sealing Face — Sealing surface surrounding the orifice of the valve body.

3.59 Valve Design — Classification of valves with regard to the valve operating mechanism.

3.60 Valve Filling Connection — Connection on the valve used to fill the cylinder.

NOTE — For most valves this connection is also used for discharging the cylinder.

3.61 Valve Inlet Connection — Connection on the cylinder valve which connects the valve to the cylinder.

3.62 Valve Operating Device — Component which actuates the valve operating mechanism. For example, hand wheel, key, toggle, knob, actuator or lever.

3.63 Valve Operating Mechanism — Mechanism which closes and opens the valve orifice and which includes the internal and external sealing systems. For example, a threaded valve spindle which, when rotated, raises and lowers a seal.

3.64 Valve Outlet Connection — Connection on the cylinder valve used to discharge the cylinder.

NOTE — For most valves this connection is also used for filling the cylinder.

3.65 Valve Test Pressure (P_{vt}) — Minimum pressure applied to valve during endurance test.

3.66 Vapour/Liquid Valve (Twin Phase Valve) — Valve designed so that either vapour or liquid may be discharged without inverting the cylinder.

3.67 Working Pressure (P_w) — Settled pressure (filling pressure) of a compressed gas (for permanent gas) at a uniform reference temperature of 15 °C in a full gas cylinder for which the valve is intended. For liquefiable gases and dissolve gases, working pressure (P_w) shall be at least the maximum developed pressure in a cylinder at a temperature of 65 °C.

4 CLASSIFICATION AND TYPES OF VALVE DESIGNS

4.1 Classification

Standard (common) valve designs based on their operating mechanism are:

a) Compression packed gland seal valves or packed valves;
b) Pressure seal valves;
c) O-ring gland seal valves; and
d) Diaphragm gland seal valves.

Standard cylinder valves have either metallic sealing or non-metallic sealing systems and may be operated by hand wheel or key or toggle.

Apart from these, there are other special types of cylinder valves designs as given below:

1) Ball valves;
2) Quick release valves; and
3) Squeeze grip valves.

NOTE — Any other valve design (other than 4.1) with prior approval of Statutory Authority.

4.2 Description of Various Valve Designs and their Common Applications

4.2.1 *Compression Packed Gland Seal Valves or Packed Valves*

Packed valves use compressed packing to make a seal around the valve spindle and valve body. The basic parts consist of valve body, spindle, gland nut and packing that is located between the gland nut or packing follower and packing ring. To ensure a good seal at the spindle, the gland nut must be firmly tightened to compress the packing against the spindle and this requires high torques to operate the valve. Compression packed gland seal valves normally have metal to metal seating (*see* Fig. 1A) but may be used with non-metallic sealing (*see* Fig. 1B). Packed valves are normally preferred with corrosive gases because of the capability of applying higher torques using a key (wrench) to shut off the valve (for example, for chlorine, ammonia and other corrosive liquefiable gases). Packed valves are seldom used above 20 MPa because of the possibility of leakage past the packing and not preferred for high purity applications because of particulate generation from packing wear and wear of the spindle against the valve seat.

4.2.2 *Pressure Seal Valves*

Pressure seal valves use a top spindle that is spring loaded against the packing. When the valve is in service; system pressure assists in creating a seal against leakage around the spindle. Pressure seal valve generally has a non-rising spindle (*see* Fig. 2). Pressure seal valves are mainly used for high pressure non-corrosive gases like Oxygen, Nitrogen, Argon, Helium etc. Pressure seal can also make use of O-rings.

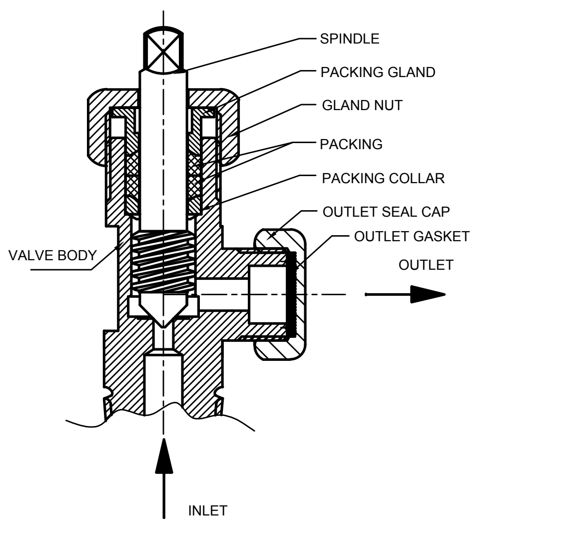


FIG-1a ILLUSTRATION OF COMPRESSION PACKED GLAND SEAL VALVE ,METAL TO METAL SEAL (KEY OPERATED)

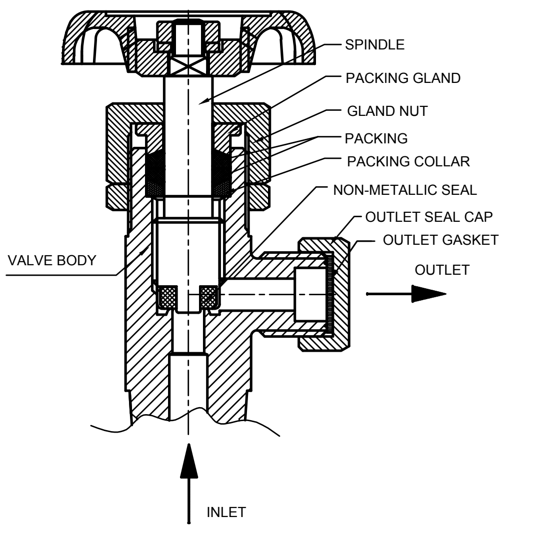


FIG-1b ILLUSTRATION OF COMPRESSION PACKED GLAND SEAL VALVE , NON-METALLIC SEAL (WHEEL OPERATED)

FIG.1 ILLUSTRATION OF COMPRESSION PACKED GLAND SEAL FOR KEY AND WHEEL OPERATED VALVE

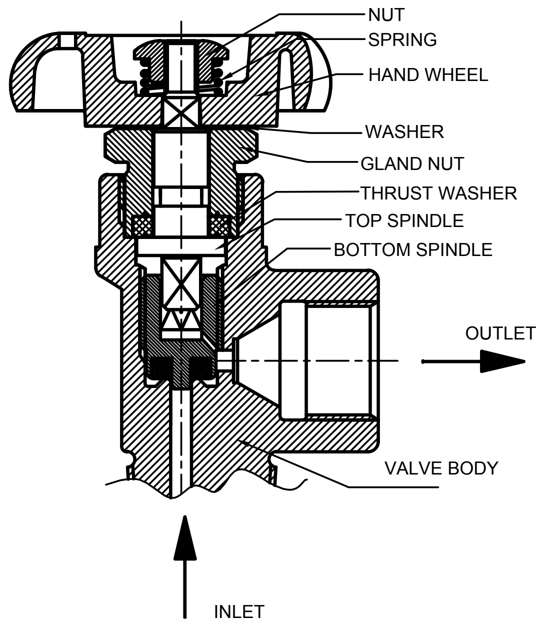


FIG. 2 ILLUSTRATION OF PRESSURE DEAL VALVE, NON METALLIC SEAL (WHEEL OPERATED)

4.2.3 *O-Ring Gland Seal Valves*

O-ring gland seal valves use one or more O-rings to create a seal around the top spindle and usually have a two piece spindle construction with a non-rising top spindle (*see* Fig. 3). O-ring gland seal valves operate at low torques at even at very high pressures and are thus widely used for a range of pressure and gas applications due to its ease of operation and low wear and tear of moving parts. These valves are therefore commonly used for oxygen, inert, carbon-dioxide, sulphur-hexaflouride and most other non-corrosive gas applications.

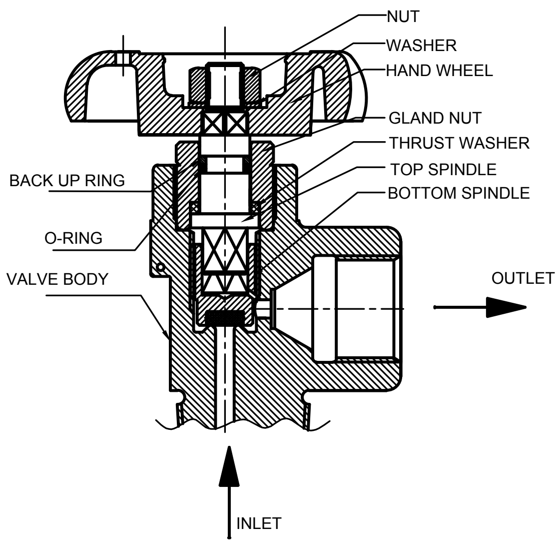


FIG. 3 ILLUSTRATION OF O-RING GLAND SEAL VALVE, NON-METALLIC SEAL (WHEEL OPERATED)

4.2.4 *Diaphragm Gland Seal Valves*

Diaphragm gland seal valves use diaphragm(s) rather than packing to seal the opening through which valve's internal parts are installed. The gland nut, which threads into the valve body, clamps the outer edges of the diaphragm against a ledge in the valve body to form a seal (*see* Fig. 4). As the diaphragm seal provides high integrity protection both for external and internal leakage, diaphragm gland seal valves are used for hazardous, toxic and high purity applications. Use of diaphragm gland seal valves is normally limited to working pressure of 205 kgf/cm^2 because above this pressure the valve becomes very difficult to operate due to the pressure force against the diaphragm(s) opposing the closing force.

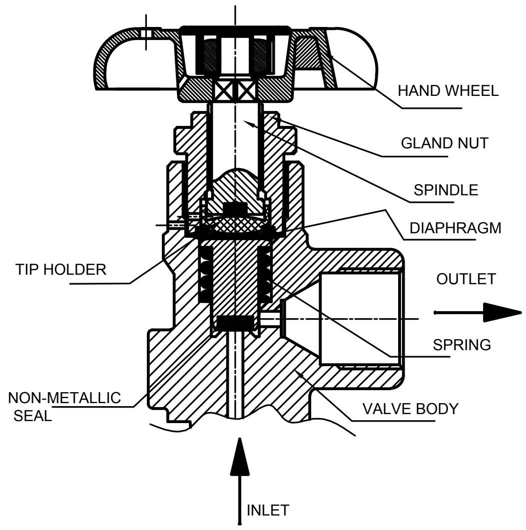


FIG. 4 ILLUSTRATION OF DIAPHRAGM GLAND SEAL VALVE, NON-METALLIC SEAL (WHEEL OPERATED)

4.2.5 *Ball Valves*

Ball valves use 90° rotation of a special designed ball to open 'on' or close 'off' the gas passage (*see* Fig. 5). It is common for ball valves to have dual outlet and are mainly used for CNG on board application. Due to sudden opening characteristics ball valves are not recommended for applications requiring controlled flow (for example, valves for oxygen service).

4.2.6 *Quick Release Valves*

Quick release valves are used in closed condition for extended periods of time and are often operated only in emergency situations (for example, fire fighting and avalanche airbag applications). In most cases, the valves are only operated once or a few times and may be associated with manually, mechanically, electrically, thermally, hydraulically, or pneumatically operated device for opening the associated sealing system.

Valves with one time actuation (*see* Fig. 6A) is for the purpose of completely discharging the pressure

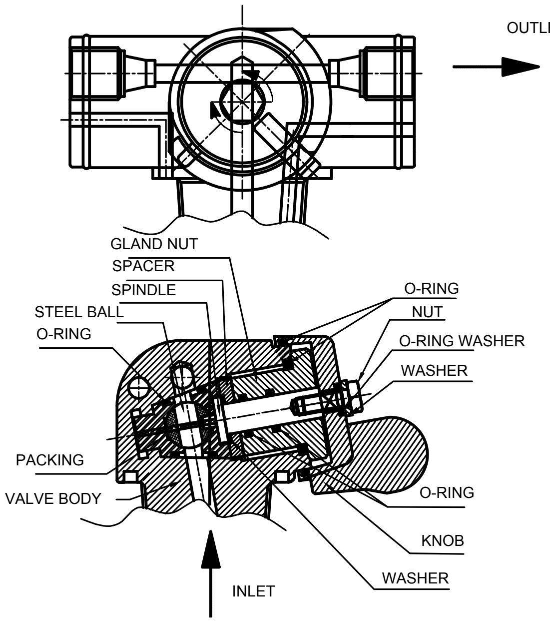


Fig. 5 Illustration of Ball Valve, Knob Operated

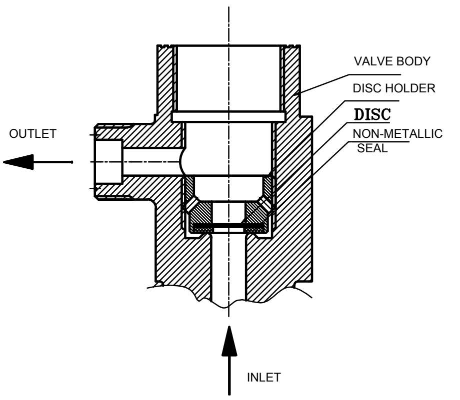


FIG-6a ILLUSTRATION OF QUICK RELEASE VALVE- ONE TIME ACTUATAION
(OPERATED BY PUNCTURING DEVICE)

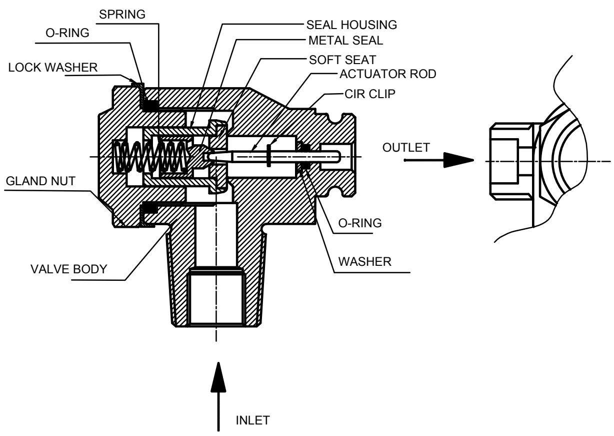


FIG-6b ILLUSTRATION OF QUICK RELEASE VALVE- MULTIPLE ACTUATAION
(ACTUATOR OPERATED)

Fig. 6 Illustration of Quick Release Valve-One Time Actuataion Operated by Puncturing and Actuator Device

receptacle whose sealing system is destroyed by the actuation device when the valve is actuated. The sealing system must be replaced or reconditioned before the valve is used again.

Valves with multiple actuation (*see* Fig. 6B) is for multiple, if necessary intermittent, actuation for the purpose of completely or partly discharging the pressure receptacle whose sealing system is not destroyed by the actuation device when the valve is actuated.

4.2.7 *Squeeze Grip Valves*

Squeeze grip valves use lever to operate the valve and are reverse seated, with pressure tending to close the valve (*see* Fig 7). In a conventional cylinder valve where the spindle rises to open, pressure tends to keep the valve open. As the cylinder pressure decreases, the total force available to sustain valve shutoff also decreases. Squeeze grip valves are mainly used for firefighting purpose.

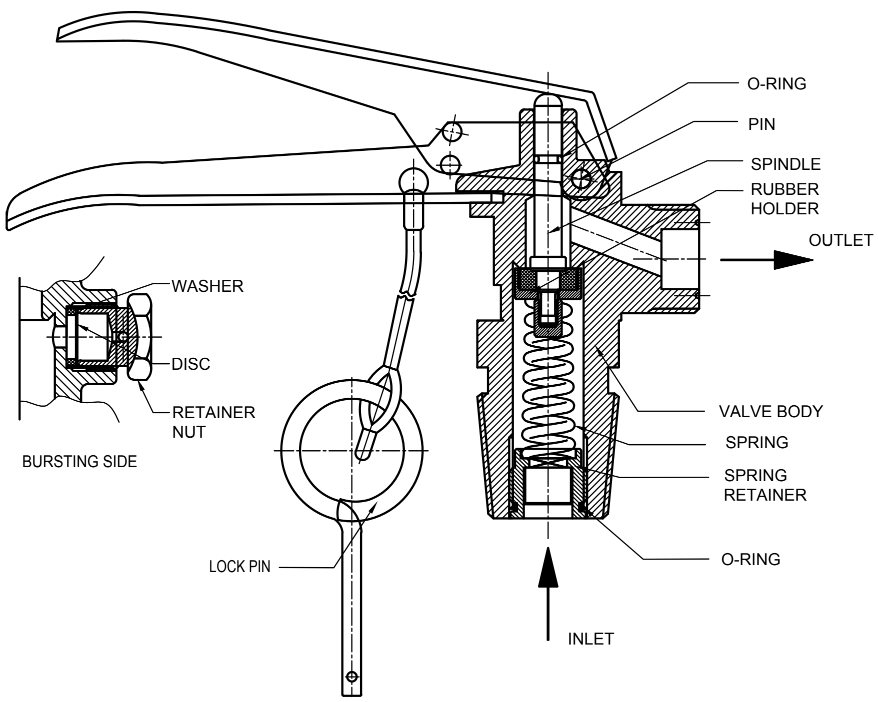


FIG. 7 ILLUSTRATION OF SQUEEZE GRIP VALVE (LEVER OPERATED)

5 SUITABILITY OF MATERIALS

5.1 Material

All materials used in the manufacture of valves, including gaskets, seats and protective coatings shall be compatible with the gas to be contained in the cylinder and shall be compatible with cylinder material. For cylinder valves used with gas mixtures, the compatibility of the materials in contact with the gas with each component of the gas mixture shall be considered. The material of the valve bodies shall comply with the material properties in **5.2**, **5.3**, **5.4** and **5.5**.

5.2 Chemical Composition

Metallic and non-metallic materials in contact with the gas shall be compatible with the gas, according to IS/ISO 11114-1 and IS/ ISO 11114-2 under all intended operating conditions. For valves used for dissolved gases, the compatibility of the materials in contact with the solvent shall also be considered. For valves used with gas mixtures, the compatibility of the gas wetted materials with each component of the gas mixture shall be considered.

When using plated or coated components in gas wetted areas the material compatibility of both, the plating/coating material and the substrate material shall be taken into account. In addition, consideration should be given to avoid flaking or particle generation, especially for oxygen, other oxidizing gases and gas mixtures containing oxygen or other oxidizing gases.

The actual chemical composition shall be the subject of agreement between the purchaser and the manufacturer except for chlorine and boron trifluoride valves.

Brass components other than valve body shall be made from free cutting brass rods (*see* IS 319) or from any forging quality brass, such as leaded brass or naval brass (*see* IS 6912).

5.2.1 Material of construction for valve of chlorine and boron trifluoride cylinders shall be as under.

5.2.1.1 *Valve body*

5.2.1.1.1 *Aluminum silicon bronze*

Chemical composition :

Copper: Remainder	Lead: 0.05 percent, *Max*	Tin: 0.20percent, *Max*
Iron: 0.30 percent, *Max*	Nickel: 0.25 percent, *Max*	Aluminum: 6.3 to 7.0 percent
Silicon: 1.5 to 2.0 percent	Manganese: 0.10 percent, *Max*	Zinc: 0.50 percent, *Max*
Arsenic: 0.15 percent, *Max*	—	—

NOTE — For guidance IS 6912 designation FABS may be referred.

Valve body forging shall be heat treated between 580 °C and 607 °C for 4 h and to be air cooled in open atmosphere.

5.2.1.2 *Valve spindle*

a) Valve spindle shall be machined from wrought nickel-copper alloy;
b) Typical composition of the alloy including admissible impurities given below are for guidance only; and

Ni (+Cobalt): 63 percent, *Min*;

Cu: 27 to 34 percent; or

Fe: 1.0 to 2.5 percent

c) Maximum admissible impurities/alloying elements: As agreed to between the purchaser and the manufacturer.

5.2.1.3 *Other extruded brass components*

Other extruded brass components for example gland nut, packing gland, packing collar, outlet cap etc.; are generally made from free cutting brass rods (*see* IS 319), naval brass, forging quality brass, such as lead brass conforming to IS 6912 or any material as agreed to be between the manufacturer and the purchaser.

5.2.2 Copper alloys in contact with oxygen or other oxidizing gases or gas mixtures shall not have aluminium content more than 2.5 percent.

5.2.3 Nickel shall not be used in gas-wetted areas with carbon monoxide due to formation of nickel carbonyl.

5.3 Mechanical Properties

The material of the valve body shall comply with the requirements of mechanical properties given in **5.3.1** and **5.3.2**.

5.3.1 *Tensile Strength and Elongation*

The tensile strength and elongation of the material of the valve body determined according to IS 1608 (Part 1) shall be respectively at least 392 MPa (40 kgf/mm^2) and minimum 18 percent measured on a gauge length $5.65\sqrt{S_o}$ (S_o being the original area of cross-section) except for valves used for CO_2 and N_2O for which the minimum tensile strength of the material of the valve body according to IS 1608 (Part 1) shall be 343 MPa (35 kgf/mm^2) and the maximum permissible tensile strength, shall be 430 MPa, minimum elongation shall be 18 percent on a gauge length $5.65\sqrt{S_o}$.

5.3.2 *Impact Strength*

The izod impact strength of valve body determined according to IS 1598, shall not be less than 21.5 J (2.2 kg.m) for brass, manganese bronze or aluminum bronze, aluminum silicon bronze and 54.9 J (5.6 kg.m) for steel.

5.4 Test Samples

Test samples for tensile and izod impact tests shall, wherever practicable, be drawn from a valve body blank; where this is not practicable, the test samples shall be made from same raw material (wrought or extruded section), giving the same outside shape as the valve body blanks it represents. The scale of sampling shall be as per Table 21 and criteria for conformity shall be in accordance with the requirements of **13.4.8**.

5.5 Protective Finishes

Protective finishes and coated components if used shall not adversely affect the performance of the valve or the materials of construction nor should they contaminate the gas.

Valves to be fitted with medical cylinders shall be bright Ni/Cr plated. Plating of the valve body shall conform to service condition 2 of Table 3 given in IS 1068. Plating shall not be carried out on gas wetted areas to avoid the flaking or particle generation and on inlet and outlet threads.

6 VALVE DESIGN REQUIREMENT

6.1 General Criteria

6.1.1 Valve shall be designed to operate satisfactorily and be leak tight over a range of service temperatures, from −20 °C to +65 °C in indoor and outdoor environments.

6.1.2 Working pressure (P_w) of the valve shall at least be the maximum developed pressure in the cylinder at a temperature of 65 °C in case of liquefiable gases or the filling pressure/settled pressure at 15 °C in case of permanent gases (*see* IS 8775 and IS 15975).

6.1.3 The component and parts of the valve of same design of a manufacturer shall be interchangeable.

6.1.4 Dip (siphon) tube and any other internal device such as filter arrangement, excess flow valve, anti-dust tube etc., shall be secured in a manner that will protect them from becoming loose or detached or break during transit and use.

6.2 Valve Dimensions

6.2.1 The Valve dimensions and connecting bore diameters shall be determined by the application of the gas, the rate of flow required, the gas service pressure, the required mechanical strength of the connections and any other safety aspects subject to agreement between the purchaser and the manufacturer.

6.2.2 The width across flat of the square of the spindle shall be as per Table 1.

Table 1 Details of Valves

(*Clauses* 6.2.2 *and* 9.1.1)

All dimensions in millimeters.

Sl No.	Gas		Designation of Screw Thread Outlet (Parallel threads) 1)	Pitch	Outlet No.	Width Across Flat of the Square of Spindle 2)
	Name	Chemical Symbol				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Acetylene	C_2H_2	G5/8-14 TPI-LH	1.814	2	7.1
ii)	Acetylene (marine lighting)	C_2H_2	G3/4-14 TPI-RH	1.814	1	8.0
iii)	Air	Air 3)	G7/8A-14 TPI-RH	1.814	19	7.1
iv)	Ammonia	NH_3	G1/2A-14 TPI-RH	1.814	9	9.5
v)	Argon	Ar	G3/4A-14 TPI-RH	1.814	20	7.1
vi)	Bromochloro-difluoro methane	$CBrCIF_2$	EXT-M22 × 1.5P-RH	1.5	18	-
vii)	Bromofluoro methane	$CBrF_3$	EXT-M22 × 1.5P-RH	1.5	18	-
viii)	Boron trifluoride	BF_3	G5/8A-14 TPI-RH	1.814	5	9.5
ix)	Butadiene	$CH_2CHCHCH_2$	G5/8-14 TPI-LH	1.814	2	7.1
x)	Carbon dioxide	CO_2	EXT-W 21.8 × 1.814-RH	1.814	7	9.5
xi)	Carbon monoxide	CO	G5/8-14 TPI-LH	1.814	2	7.1
xii)	Chlorine	Cl_2	G5/8A-14 TPI-RH	1.814	5	9.5
xiii)	Chlorine trifluoride	ClF_3	G5/8A-14 TPI-RH	1.814	5	9.5
xiv)	Chloro difluoro methane	$CHCIF_2$	G5/8A-14 TPI-RH	1.814	5	9.5
xv)	Chloro trifluoro methane	CF_3CI	G5/8A-14 TPI-RH	1.814	5	9.5
xvi)	Coal gas	Coal 3)	G5/8-14 TPI-LH	1.814	2	7.1
xvii)	Compressed natural gas for automotive use	CNG 4)	G5/8-14 TPI-LH	1.814	21	7.1
xviii)	Compressed natural gas for automotive use	CNG 4)	INT-M12 × 1P-RH	1.00	21a	5.0
xix)	Cyanogen	$(CN)_2$	G3/4A-14 TPI-LH	1.814	17	7.1
xx)	Dichloro-difluoro methane	CCl_2F_2	G5/8A-14 TPI-RH	1.814	5	9.5
xxi)	Dichloro-fluoro methane	$CHCl_2F$	G5/8A-14 TPI-RH	1.814	5	9.5
xxii)	Difloro methane	CH_2F_2	G5/8-14 TPI-RH	1.81	5	9.5
xxiii)	Dimethylamine	$(CH_3)_2NH$	G5/8A-14 TPI-LH	1.814	6	9.5
xxiv)	Dimethyl ether	CH_3OCH_3	G5/8-14 TPI-LH	1.814	2	7.1
xxv)	Ethylchloride	C_2H_5CI	G5/8A-14 TPI-LH	1.814	6	9.5
xxvi)	Ethylamine	$C_2H_5NH_2$	G1/2A-14 TPI-LH	1.814	10	9.5
xxvii)	Ethylene	C_2H_4	G5/8-14 TPI-LH	1.814	2	7.1
xxviii)	Ethylene oxide	C_2H_4O	G5/8A-14 TPI-LH	1.814	6	9.5
xxix)	Helium	He	G3/4A-14 TPI-RH	1.814	20	7.1
xxx)	Hydrogen	H_2	G5/8-14 TPI-LH	1.814	2	7.1
xxxi)	Hydrogen chloride	HCI	G5/8A-14 TPI-RH	1.814	5	9.5
xxxii)	Hydrogen cyanide	HCN	G3/4A-14 TPI-LH	1.814	17	7.1
xxxiii)	Hydrogen fluoride	HF	G5/8A-14 TPI-RH	1.814	5	9.5
xxxiv)	Hydrogen Sulphide	H_2S	G3/8A-19 TPI-LH	1.337	14	7.1
xxxv)	Isobutylene	$(CH_3)_2C:CH_2$	G5/8-14 TPI-LH	1.814	2	7.1
xxxvi)	Krypton	Kr	G3/4A-14 TPI-RH	1.814	20	7.1
xxxvii)	Methane	CH_4	G5/8-14 TPI-LH	1.814	2	7.1
xxxviii)	Methyl bromide	CH_3Br	G1/4A-14 TPI-RH	1.337	15	7.1

Table 1 (*Concluded*)

Sl No.	Gas		Designation of Screw Thread Outlet (Parallel threads) 1)	Pitch	Outlet No.	Width Across Flat of the Square of Spindle 2)
	Name	Chemical Symbol				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
xxxix)	Methyl chloride	CH_3CI	G5/8A-14 TPI-LH	1.814	6	9.5
xl)	Methylamine	CH_3NH_2	G1/2A-14 TPI-LH	1.814	10	9.5
xli)	Neon	Ne	G3/4A-14 TPI-RH	1.814	20	7.1
xlii)	Nitrogen	N_2	G3/4A-14 TPI-RH	1.814	20	7.1
xliii)	Nitrous oxide	N_2O	EXT-W17.42 × 1.27-RH	1.270	12	6.0
xliv)	Oxygen	O_2	G5/8-14 TPI-RH	1.814	3	7.1
xlv)	Phosgene	$COCI_2$	G5/8A-14 TPI-RH	1.814	5	9.5
xlvi)	Sulphur dioxide	SO_2	G1/2A-14 TPI-RH	1.814	11	9.5
xlvii)	Sulphur hexafluoride	SF_6	G5/8A-14 TPI-RH	1.814	5	9.5
xlviii)	Trichlorofluoro methane	$CFCI_3$	G5/8A-14 TPI-RH	1.814	5	9.5
xlix)	Trimethylamine	$(CH_3)_3N$	G5/8-14 TPI-LH	1.814	6	9.5
l)	Vinyl chloride	C_2H_3CI	G5/8A-14 TPI-LH	1.814	6	9.5
li)	Xenon	Xe	G3/4A-14 TPI-RH	1.814	20	7.1

Key

1) In this standard, valve outlet threads describe type of thread that is whether they are external or internal, right hand or left-hand type, fastening pipe thread or Whitworth or metric threads.

G = Stands for fastening pipe thread as per IS 2643, symbol A indicates external thread of class A. Absence of A indicates internal thread.

W = Stands for Whitworth thread.

M = Stands for metric thread.

Ext = External thread, Int = internal thread.

2) The width across flat shall be applicable to the valve spindles when the valve is not provided with lever, knob, or hand wheel but it is opened or closed with spanners or keys.

3) Being mixture of gases does not have a chemical symbol but mentioned for identification. For gas mixtures, outlet connection to be used shall be subject to agreement between the purchaser and manufacturer in consultation and approval of the statutory authority.

4) Outlet connection for CNG valves shall be subject to agreement between the purchaser and the manufacturer.

6.2.3 Valve Inlet dimensions shall be as per **8**.

6.2.4 Valves outlet dimension shall be as per **9**.

6.3 Valve Operating Mechanism

The valve operating mechanism shall fulfill the requirements of **6.3.1**, **6.3.2** and **6.3.3**.

6.3.1 It shall be possible to open and close the valve at pressures up to p_{vt} (*see* **10.3.2**) without using any additional equipment not recommended by the manufacturer. This shall be verified during endurance test, (*see* **10.6**).

It should be designed in such a way that the setting of the operating position of the valve cannot be inadvertently altered, i.e. if the valve is closed it should remain closed during normal service or normal transport.

6.3.2 It shall withstand over torque (T_o) without damage or failure of any component of the valve operating mechanism and/or valve operating device. Both (T_o) and (T_f) shall not be less than the valves given in Table 2. Mechanical failure shall occur before unscrewing of the valve operating mechanism and shall be in a manner that will not result in ejection of the valve components.

For key operated valves, refer Table 2, the failure torque (T_f) will be determined by excessive torque test. The excessive torque test is given in **10.4.4**.

NOTE — This requirement is not applicable if an excessive torque cannot be applied for example, for lever operated valves, for valves with pneumatic actuator.

Table 2 Torques to be Used for the Endurance Test and Excessive Torque Tests

(*Clauses* 6.3.2, 6.3.3, 10.4.2.5, 10.4.2.11, 10.4.4.2.1, 10.4.4.2.5, 10.4.4.3.3, 10.6.1.2, 10.6.1.9, 10.6.1.11 *and* 10.6.1.12)

Sl No.	Valve Design as Given in 4.1	Valve Seal/Seat	Valve Operating Device	Endurance Torque T_e (With a Relative Tolerance of $^{+10}_{-0}$ Percent)	Over Torque T_o (in Nm)	Failure Torque T_f (in Nm)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	O-ring gland seal valve, Pressure seal valve and Ball valve	Nonmetallic	a) Hand wheel diameter D = 65 mm	7 Nm	20	25
			b) Hand wheel of Other diameter	$D \times 7/65$ Nm	$D \times 20/65$	$1.25 \times T_o$
			Key/toggle	$T_o/3$	$T_f/1.25$	T_f
ii)	Diaphragm gland seal valve, compression packed gland seal valve	Nonmetallic	c) Hand wheel diameter D = 65 mm	$T_{e.start} = 7$ Nm $T_{e.end} \leq 10.5$	20	25
			d) Hand wheel of Other diameter	$T_{e.start} = D \times 7/65$ Nm $T_{e.end} \leq 1.5 \times T_{e.start} \leq 16$ Nm	$D \times 20/65$	$1.25 \times T_o$
			e) Key/toggle	$T_{e.start} = T_o/3$ $T_{e.end} \leq 1.5 \times T_{e.start}$	$T_f/1.25$	T_f
iii)	O-ring gland seal valve, Diaphragm gland seal valve and compression packed gland seal valve	Metal to Metal	f) Hand wheel diameter D = 65 mm	$T_{e.start}$ is to be specified by the manufacturer. But $T_{e.start}$ shall not less than $1.5 \times T_c$ and not less than 7 Nm. $T_{e.end} \leq 1.5 \times T_{e.start} \leq 16$ Nm	20	25
			g) Hand wheel of pther diameter	$T_{e.start}$ is to be specified by the manufacturer. But $T_{e.start}$ shall not less than $1.5 \times T_c$ and not less than $D \times 7/65$ $T_{e.end} \leq 1.5 \times T_{e.start} \leq 16/65$ Nm	$D \times 20/65$	$1.25 \times T_o$
			h) Key/toggle	$T_{e.start} = T_c$ $T_{e.end} \leq T_o$	$T_f/1.25$	T_f

NOTES

1 Standard industry practice is to apply a 7 Nm closing torque on commonly used 65 mm hand wheel diameter valves during operation.

2 There is a general consensus that a nominal maximum torque of 16 Nm can be achieved by hand with a 65 mm hand wheel diameter.

3 If a valve design is not covered by this table, the valve manufacturer shall specify the torques used and test parameters and include in the drawing.

6.3.3 It shall function satisfactorily after 2 000 opening and closing cycles with endurance torque (T_e) at valve test pressure (P_{vt}) without replacement of the sealing system. T_e is given in Table 2 and for some valve designs is allowed to be increased during the given cycles. For compression packed valves, if needed, adjustment of the packing nut according to the manufacturer's specification is permitted.

NOTES

1 This requirement is not applicable for quick release valves used for one time actuation.

2 For special designs, the number of cycles shall be defined by the manufacturer on the basis of a specification from the customer or industry based the likely service conditions. The number of cycles shall be documented in the drawing.

3 The endurance test is given in **10.6**.

4 After the endurance test and the subsequent leak tightness tests have been performed a visual examination shall be carried out to ensure that no components are displaced (no longer in the place where it was installed), non-functional (for example, broken) or missing.

5 The visual examination is given in **10.7**.

6.4 Valve Operating Device

6.4.1 If the valve operating mechanism closes the valve by rotation, this shall be in clockwise direction when viewed from the spindle end.

6.4.2 Hand wheel or knob, wherever provided shall be clearly marked with 'Open' or 'Close' positions in words.

6.4.3 For manually operated valves the valve operating device shall be designed to permit the closure of the valve after exposure to a flame. Although the valve operating device may be damaged during the test, a manually operated valves shall still be possible to be closed by hand or using a simple tool after cooling. For other than manually operated valves, it shall be verified that either the valve operating mechanism is still functioning (open/close) or that the valve is in the closed position. The flame Impingement test is given in **10.8**.

6.5 Safety

6.5.1 The valve stem shall be of sufficient strength to withstand valving torque. Valving torque test is given in **10.4.3**.

6.5.2 Cylinder valves shall be capable of withstanding valve burst test pressure (P_{vbt}). Valve burst pressure test is given in **10.4.1**.

6.5.3 Cylinder valves shall be capable of withstanding valve impact test. Valve Impact test is given in **10.4.2**.

6.5.4 Cylinder valves for ammonia, carbon monoxide, chlorine, chlorine trifluroide, cyanogens chloride, fluorine, hydrogen sulphide, methyl bromide, boron trifluoride and sulphur dioxide shall be provided with a metallic security nut on the outlet in service to act as a secondary means of safeguard against the leakage of gas. The material of the security nut and the gasket shall be compatible with the gas to be contained in the cylinder and also with the valve body material.

6.5.5 CNG valves may be fitted with excess flow check valve if required by customer.

6.5.5.1 The body/housing of the excess flow check valve shall be made from extruded/extruded and forged brass. The excess flow check valve shall be fitted on valve.

6.5.5.2 Excess flow check valve shall be designed with bypass to allow for equalization of pressure and shall meet activation and flow requirements specified in **12.2** and **12.3**. Type test for excess flow valve for CNG valves is given in **12**.

6.6 Leakage

6.6.1 The internal leakage shall not exceed 6 cm^3/h corrected to NTP over the range of pressures and temperatures specified in the Table 3 and Table 4, with the operating mechanism in the 'fully closed' position. (*see* **10.5.2**).

6.6.2 The external leakage shall not exceed 6 cm^3/h corrected to NTP over the range of pressures and temperatures specified in Table 3 and Table 4, with the operating mechanism in different positions, if applicable between and including the 'fully open' and the 'closed' positions (*see* **10.5.3**).

NOTE — The leakage of 6 cm^3/h is approximately 4 bubbles of 3.5 mm diameter per min.

7 PRESSURE RELIEF DEVICES

7.1 Design Criteria of Pressure Relief Devices

The materials, design and construction of a pressure relief device shall be such that it meets the following conditions.

7.1.1 There shall be no significant change in the function of the device and no detrimental corrosion or deterioration of the materials due to normal service conditions of the cylinder to which it is fitted.

7.1.2 The breakage or failure of any internal component of the valve shall not obstruct free and full flow of the gas through the pressure relief device.

7.1.3 The material of construction shall be compatible with the gas(es) to be conveyed and other service conditions.

7.1.4 The design shall be, such as to deter any unauthorized interference with the assembly and/or setting of the device.

Table 3 Test Schedule for Type Testing (No Variants)

(*Clauses* 6.6.1, 6.6.2, 10.1.1, 10.1.4 *and* 10.5.1 *and Table* 18)

Sl No.	Test Schedule	Test and Relevant Subclause	Condition of Test Sample	Test Temperature °C	Test Pressure Bar	Test Sample Number	Number of Tests Per Sample	Total Number of Tests
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	1	Hydraulic burst pressure, **10.4.1**	As received	Room temperature	P_{vbt}	1	1	1
ii)	2	Excessive torque, **10.4.4**	As received	Room temperature	–	7 to 10	1	4
iii)	3	Internal/external leak tightness, **10.5**	As received	Room temperature	*See* Table 4	2 to 6	6	30
iv)	4	Endurance, **10.6**	From test 3	Room temperature	P_{vt}	2 to 6	1	5
v)	5	Internal/external leak tightness, **10.5**	From test 4	Room temperature	*See* Table 4	2 to 6	6	30
vi)	6	Internal/External leak tightness, **10.5**	From test 5	$-20^{\ 0/-5}$	*See* Table 4	2 to 6	6	30
vii)	7	Internal/external leak tightness, **10.5**	From test 6	$65^{\ +2.5/-2.5}$	*See* Table 4	2 to 6	6	30
viii)	8	Visual examination **10.7**	From test 7	Room temperature	–	2 to 6	1	5
ix)	9	Flame impingement **10.8** (only required for hand wheel/knob operated valve)	As received	Room temperature	–	11	1	1
Pressure relief device test (for valves equipped with PRD)								
x)	10	Flow capacity of the PRD, **10.9**	As received	Room temperature	5.9	15 to 17	3	3
Mechanical test								
xi)	11	Valve impact test, **10.4.2**	As received	Room temperature	–	As marked	One from each category covered in the drawing	AS applicable
xii)	12	Valving torque test, **10.4.3**						

Note — For additional material variants, test sample numbers and number of tests will change (*see* **10.10**).

7.1.5 The outlets from all pressure relief devices shall be so positioned that free discharge from the devices is not impaired. The discharge so coming out shall not come out as a single high velocity jet emerging radially to the axis of the cylinder to avoid injury to individuals working in that area. The yield temperature of the fusible plugs, if used with acetylene shall be between 98-104 °C and for compressed natural gas shall be 125 ± 10 °C.

Table 4 Test Pressures for Leak Tightness Test

(*Clauses* 6.6.1, 6.6.2, 10.5.1, 10.5.2, 10.5.3 *and* 10.6.1.11 *and Table* 3)

0.5 bar
10 bar
P_{vt}

7.1.6 The minimum rated flow capacity of the pressure relief devices fitted to non-insulated cylinders having water capacity of 11 litre or more shall be as follows:

a) For permanent gases, $Q_1 = 0.009\ 67\ W_c$,

where Q_1 is the rated flow capacity in cubic metres per minute of free air at 6 kgf/cm^2 gauge pressure, and W_c is the water capacity of the cylinder in litres.

b) For liquefiable gases: The rated flow capacity of the pressure relief devices shall be twice that given in item (a) above.

For cylinders having water capacities of less than 11 litre, the rated flow capacities shall be as given in (a) or (b) above, except that the value of W_c shall be 11 litre.

7.2 Relief/Bursting Pressure

7.2.1 Where the pressure relief device is a bursting disc fitted to the valve of seamless or welded cylinder the bursting pressure of the disc (when tested at temperature of 65 °C) shall not exceed the test pressure of the cylinder for which device is intended and shall be more than the developed pressure of the gas at 65 °C. Bursting disc may be rated at room temperature provided correlation between room temperature and elevated temperature is determined.

7.2.2 Valves used for high pressure liquefiable gas such as CO_2 and N_2O shall be fitted with bursting disc type safety relief device [type BD of IS 5903].

The rated bursting pressure shall meet the requirement of **7.2.1** and same will be specified in the drawing.

The actual burst pressure of the disc shall not be in excess of its rated burst pressure and not less than 90 percent of its rated burst pressure.

7.2.3 Valves for cylinders for compressed natural gas (CNG) shall be provided with bursting disc and fusible plug either in series (combination) or in parallel.

7.2.4 *Safety Device Bursting Disc and Fusible Plug when Placed in Series Combination*

In combination safety relief device, bursting disc is backed by fusible metal. The device is activated by a combination of high temperature and pressure acting together.

7.2.5 *Safety Device Bursting Device and Fusible Plug when Placed in Parallel Combination*

In a parallel safety relief device, fusible plug and bursting disc are activated independently by high temperature and high pressure respectively.

7.3 Installation and Application of Pressure Relief Devices

7.3.1 Valves to be fitted to cylinders for a toxic gas shall not be fitted with a pressure relief device.

7.3.2 For any other valves, the PRD if required shall be fitted in consultation with statutory authority.

NOTE — The PRD's shall be subjected to periodic inspection by the user as required or during periodic inspection of the cylinder.

8 INLET CONNECTIONS

The valve inlet connection shall be provided with either taper (*see* **8.1**) or parallel (*see* **8.3**) threads.

NOTE — See Annex B regarding thread code for inlet connection.

8.1 Taper Screw Threads

Taper screw threads shall be any one of the types specified below:

Type 1 thread - Taper 1 : 16 on diameter (*see* **8.1.1**)

Type 2 thread - Taper 3 : 25 on diameter (*see* **8.1.2**)

Type 4 thread - Taper 1 : 8 on diameter (*see* **8.1.3**)

NOTES

1 Type 3 threads with a taper of 6° included angle are covered in IS 8737.

2 Threads may be without undercut provided minimum length of full threads as specified in Table 5, Table 6 and Table 7 are maintained.

8.1.1 *Type 1 Threads (Size 1, Size 2 and Size 3) with a Taper of 1 in 16 on Diameter*

The basic thread form, the principal dimensions and limits of crest and root truncation of the threads are shown in Fig. 8A), 8B) and Table 8. Thread form shall be perpendicular to the axis.

NOTE — This type of thread also conforms to CGA Standard V-1-2013 'Standard for compressed gas cylinder valve outlet and inlet connections'. The NGT threads are based on the American standard taper pipe threads but are longer to provide fresh threads if further tightening is necessary. They have their own tolerances, which require gauges specifically developed for these threads.

8.1.1.1 *Limits on size*

For final inspection, limits on size (pitch diameter) of both external and internal thread are ± 1 turn from basic, although the preferred working limits are ± $^1/_2$ turn from basic.

8.1.1.2 *Limits on taper*

Should there be an unintentional difference in taper at the pitch elements of the valve and of the cylinder threads, it is preferred to have greater tightness at the bottom of the valve. In view of this requirement, the limits in gauging shall be as under:

a) The taper on pitch elements of external threads shall be 1 in 16 on diameter with a minus tolerance of 1 turn but no plus tolerance in gauging; and
b) The taper on pitch elements of internal threads shall be 1 in 16 on diameter with a plus tolerance of 1 turn but no minus tolerance in gauging.

8.1.1.3 The tolerance on 60° angle of thread shall be ± 2°.

8.1.1.4 The tolerance on lead in the length of effective threads shall be ± 0.0762 mm valid for any size threaded to a thread length greater than 25.4 mm.

8.1.1.5 The maximum taper on pitch line per millimeter shall be 0.0729 and minimum 0.0573.

8.1.1.6 Type 1 threads shall be checked according to IS 15894.

8.1.2 *Type 2 Threads (Size 1 and Size 2), with a Taper of 3 in 25 on Diameter*

The basic form, principal dimensions and their limits are given in Fig. 9A), 9B) and Table 6.

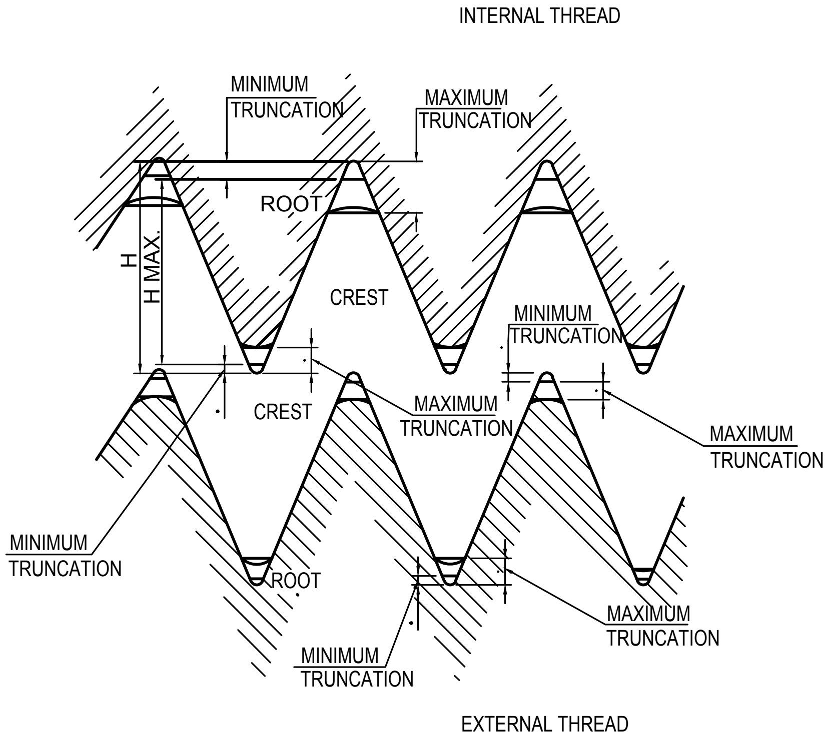


FIG. 8a - THREAD DETAILS AND LIMITS ON CREST AND ROOT TRUNCATION ON DIFFERENT TYPES OF TAPER SCREW THREAD

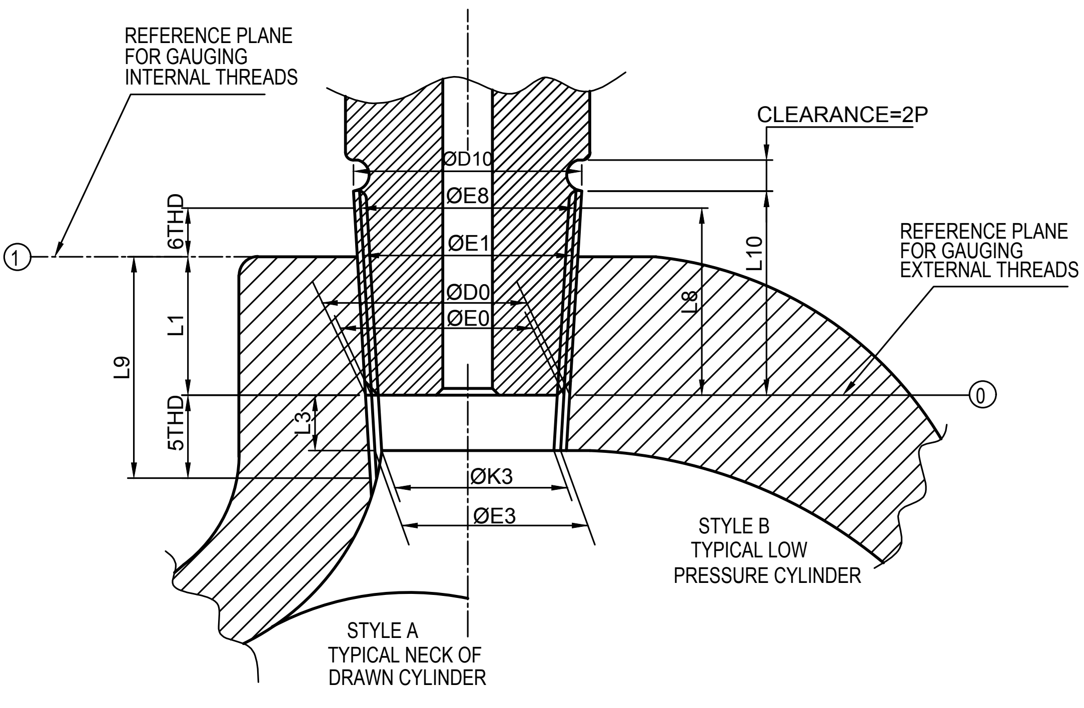
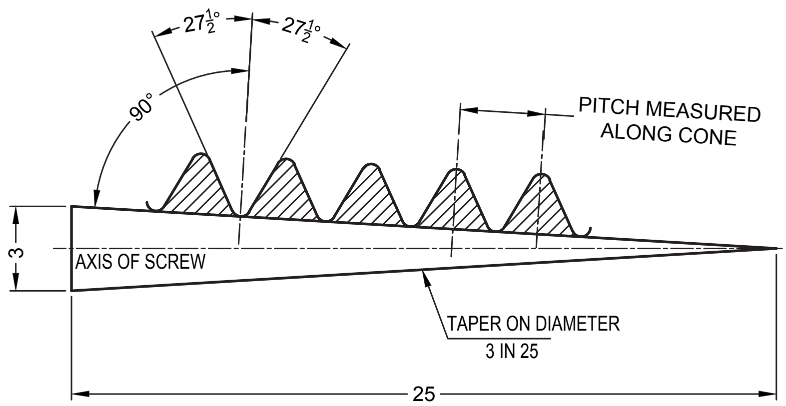


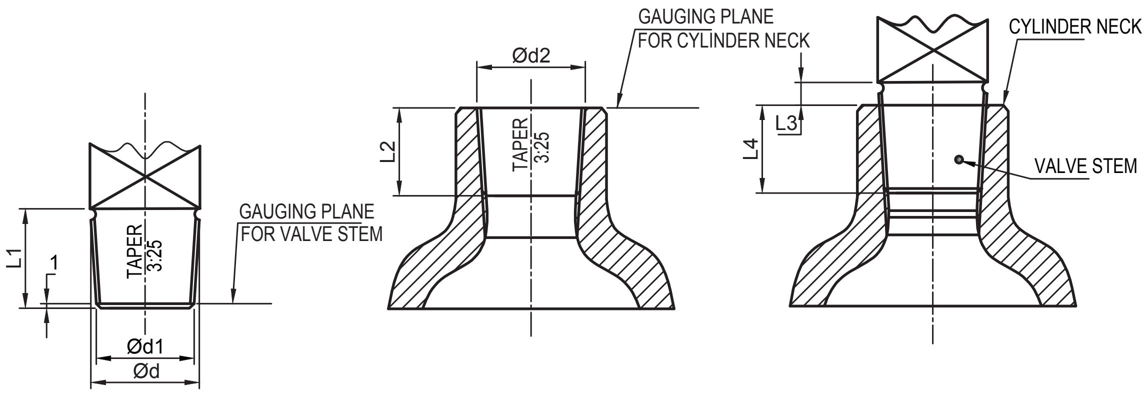
FIG. 8b LIMITS ON CREST AND ROOT TRUNCATION ON DIFFERENT TYPES OF TAPER SCREW THREAD

Fig. 8 Thread Parameters and Limits on Crest and Root Truncation on Different Type Screw Thread



PITCH -1.814 mm, ANGLE - 55°, TAPER - 3 IN 25 ON DIAMETER

FIG. 9a - BASIC THREAD FORM OF TYPE 2 THREAD, RIGHT HAND
NORMAL TO SURFACE OF CONE



NORMAL DIAMETER OF VALVE 1)	VALVE INLET THREAD			THREAD IN CYLINDER NECK		LENGTH OF THREAD AT THEORETICAL THREAD DIAMENSIONS	
	d +0.12	d_1 + 0.12	L_1	d_2 - 0.12	L_2 MIN	L_3	L_4
19.8	19.8	17.4	21	19.2	17	5.0	16.0
28.8	28.8	25.8	26	27.8	22	8.33	17.67

FIG. 9b - PRINCIPAL DIMENSIONS FOR TYPE 2TAPER THREADS ON
VALVE STEM AND IN CYLINDER NECK

FIG. 9 BASIC FORM AND PRINCIPAL DIMENSIONS FOR TYPE 2 TAPER THREADS

Table 5 Dimensions for Type 1 Taper Threads on Valve Stems and in Cylinder Necks

(*Clause* 8.1)

All dimensions in millimeters

Sl No.	**Thread Designation**		**Hand Tight Engagement L_1**	**External Threads (on Valve Stem)**							**Internal Threads (in Cylinder Neck)**					
				Small End			Full Threads		Large End		Pitch Dia at Face E_1	Counter 90º X Max Dia KK	Full Threads			
				Major Dia D_o	Pitch Dia E_o	Chamfer – 45º X Min Dia	Pitch Dia E_8	Length L_8	Major Dia D_{10} approx	Overall Length L_{10} approx			Bore Max K_3	Pitch Dia E_3	Length L_1+L_3	Length of Full Root Min L_9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
i)	Size 1	½-14 NGT	8.123	20.716	19.263	17.5	20.452	19.014	21.9	20.6	19.771	22.5	17.473	18.923	13.571	17.198
ii)	Size 2	¾-14 NGT	8.611	26.03	24.58	23	25.799	19.497	27.42	23	25.118	27	22.79	24.24	14.05	17.681
iii)	Size 3	1-11 ½ NGT	10.160	32.593	30.825	28.6	32.288	23.411	34.2	25.4	31.460	33.3	28.646	30.411	16.787	21.2

Table 6 Limits on Principal Dimensions for Type 2 Threads

(*Clauses* 8.1 *and* 8.1.2)

All dimensions in millimeters

Sl No.	Nominal Diameter of Valve	Thread Element	Diameter of Thread on Valve Stem				Diameter of Thread at Mouth of Cylinder Neck	
			At small end d_1		At large end d			
			Max	*Min*	*Max*	*Min*	*Max*	*Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	19.8	Major dia	17.52	17.40	19.92	19.80	19.200	19.080
		Pitch dia	16.358	16.238	18.758	18.638	18.038	17.918
		Minor dia	15.196	15.076	17.596	17.476	16.878	16.778
ii)	28.8	Major dia	25.920	25.800	28.920	28.800	27.800	27.680
		Pitch dia	24.758	24.638	27.758	27.638	26.638	26.518
		Minor dia	23.596	23.476	26.596	26.476	25.476	25.356

Table 7 Principal Dimensions of Type 4 Taper Screw Threads on Valve Stems and in Cylinder Neck

(*Clauses* 8.1 *and* 8.1.3)

All dimensions in millimeters

Sl No.	Size Designation	Nominal Size of Valve *A*	Taper on Diameter	Pitch Measured Along the Cone	Stem Major dia *A* Max	Length of Thread *B*	Cylinder neck major dia *C* Min	Length of Engagement Min	Length of Thread in Cylinder neck *D* Min
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Size 1	18.16	1 : 8	1.8143	18.160	$22.23\,^{+3.17}_{0}$	20.142	15.88	22.23
ii)	Size 2	25.40	1 : 8	1.8143	25.400	$25.40\,^{+3.17}_{0}$	27.788	19.05	25.40
iii)	Size 3	31.75	1 : 8	2.3091	31.750	$31.75\,^{+3.17}_{0}$	34.925	25.40	31.75

Table 8 Thread Details for Type 1 Threads

(*Clause* 8.1.1)

All dimensions in millimeters

Sl No.	Parameter		Thread Size 1 and 2 that is, ½ - 14 NGT and ¾ - 14 NGT	Thread Size 3 i.e., 1 – 11½ NGT
(1)	(2)		(3)	(4)
i)	*p*	Pitch	1.814	2.208 7
ii)	*H*	Height of sharp V thread 0.866 025 *p*	1.571 22	1.913 2
iii)	*h*	Height of thread on product 0.800 025 *p*, *Max* 0.710 025 *p*, *Min*	 1.451 1.288	 1.767 1.568
iv)	*f*	Truncation on crest and root 0.033 *p*, *Min* 0.078 *p*, *Max* Tolerance	 0.059 87 0.141 51 0.081 64	 0.072 88 0.172 28 0.099 4
v)	*F*	Equivalent width of flat 0.038 *p*, *Min* 0.090 *p*, *Max* Tolerance	 0.068 94 0.163 29 0.094 35	 0.083 93 0.198 78 0.114 85

Table 9 Limits for Type 4 Taper Screw Threads on Valve Stems and in Cylinder Necks

(*Clause* 8.1.3)

All dimensions in millimeters

Size Designation	Nominal Size of the Valve	Thread Element	Diameter of Thread on Valve Stem at Small End		Diameter of Thread at Mouth of Cylinder	
			A		C	
			Max	*Min*	*Max*	*Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Size 1	18.16	Major dia	18.160	17.958	20.414	20.142
		Pitch dia	16.998	16.863	19.114	18.979
		Minor dia	15.834	15.563	18.019	17.816
Size 2	25.40	Major dia	25.400	25.197	28.059	27.788
		Pitch dia	24.237	24.102	26.759	26.624
		Minor dia	23.073	22.802	25.664	25.461
Size 3	31.75	Major dia	31.750	31.483	35.281	34.025
		Pitch dia	30.269	30.091	33.622	33.444
		Minor dia	28.788	28.433	32.230	31.963

NOTE — This type of thread also conforms to DIN 477-1 : 1990 'Gas cylinder valves – Types, sizes and outlets' and ISO 11363-1 : 2010 'Gas cylinders 17 E and 25 E taper threads for connection of valves to gas cylinder'. The 17 E and 25 E threads have profile normal to the cone.

8.1.2.1 Type 2 threads shall be inspected as per IS 9122.

8.1.3 *Type 4 Threads (Size 1, Size 2 and Size 3) with a Taper of 1 in 8 on Diameter*

The basic thread form, principal dimensions and their limits are given in Fig. 10A), 10B) and in Table 7 and Table 9 respectively.

8.1.3.1 Type 4 threads shall be checked according to IS 7202.

8.2 Oversized Threads on Valve Stems

8.2.1 *Type 1 Threads*

For valve fittings with Type 1 inlet threads on stem, the oversized dimensions are given in Table 10 to be read with Fig. 8A) and Fig. 8B).

8.2.2 *Type 4 Threads*

For valve fittings with Type 4 inlet threads on stem, the oversize dimensions are given in Table 11 read with Fig. 10A) and Fig. 10B).

8.3 Parallel Threads on the Valve Stem with Cylinder Neck Dimensions

8.3.1 The valve inlet shall be provided with any one of the following parallel thread as specified below:

a) M18 × 1.5 metric thread;
b) M25 × 2.0 metric thread;
c) M30 × 2.0 metric thread;
d) ¾ – 16 UNF thread;
e) $1^1/_8$ – 12 UNF thread; and
f) ¾ – 14 NPSM thread (Also known as ¾ NGS thread).

NOTE — Any other parallel thread may be used with approval of Statutory Authority.

The principal dimensions are shown in Fig. 11 to be read with Table 12 and the basic thread form of the threads are shown in Fig. 12A), 12B) and 12C).

NOTE — For checking parallel threads:

a) For metric threads IS 2334 may be referred.
b) For UNF threads the standard ANSI/ASME B1.2-1983 may be referred.
c) For NPSM threads the standard ANSI/ASME B1.20-1-1983 may be referred.

8.3.2 The dimensions of the O-rings are shown in Table 12. If other dimensions and tolerances of O-rings are used, it shall be verified by the valve manufacture that performance (for example, compression set, fill factor) is not compromised. The O-ring shall have a hardness of 90 shore A (nominal) and shall be of a material compatible with the nature of the gas contained in the cylinder (*see* IS/ISO 11114-2).

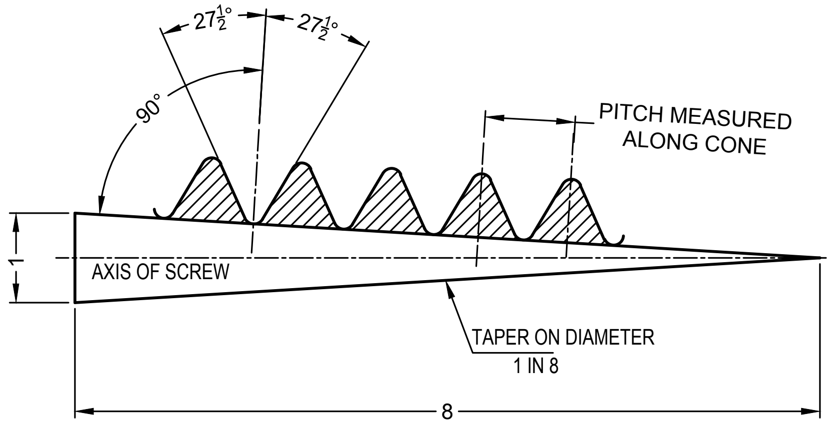


FIG. 10a - BASIC THREAD FORM OF TYPE 4 THREAD ON VALVE STEM AND IN CYLINDER NECK (THREAD PROFILE IS PERPENDICULAR TO CONE)

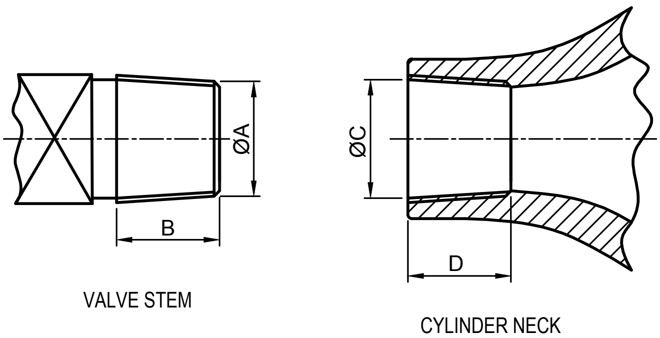


FIG. 10b - PRINCIPAL DIMENSIONS FOR TYPE 4 TAPER THREAD, RIGHT-HAND NORMAL TO SURFACE CONE (THREAD PROFILE IS PERPENDICULAR TO CONE)

Fig. 10 Basic Form and Principal Dimensions for Type 4 Taper Threads

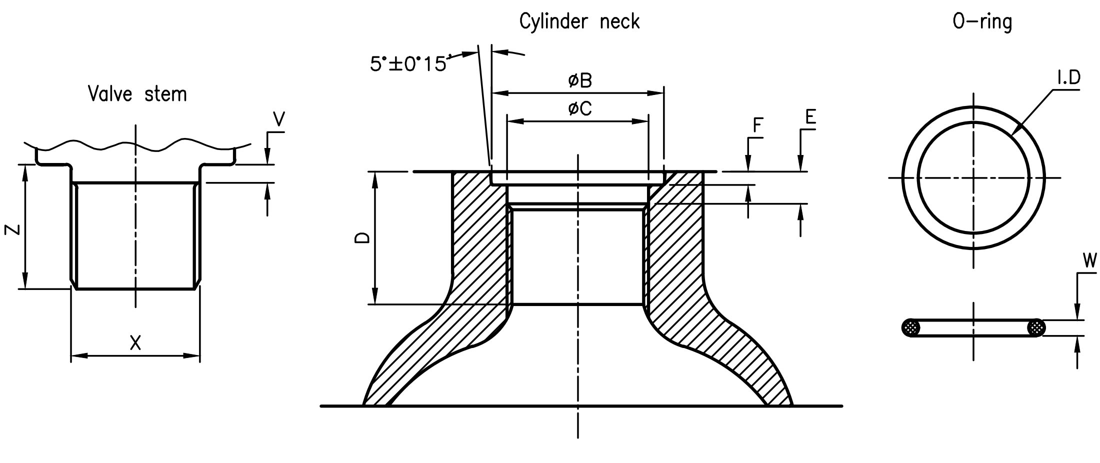
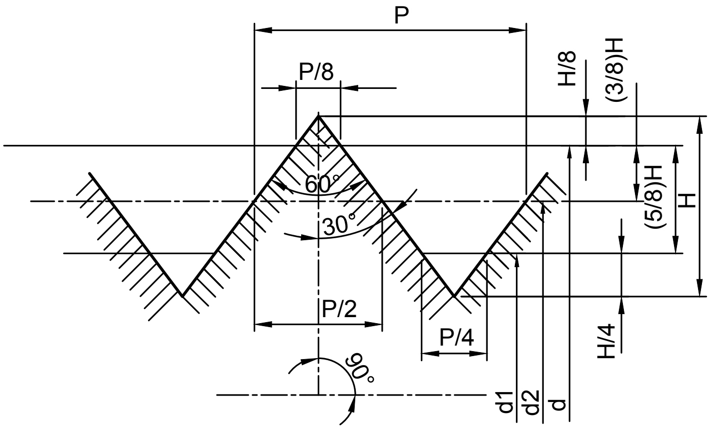
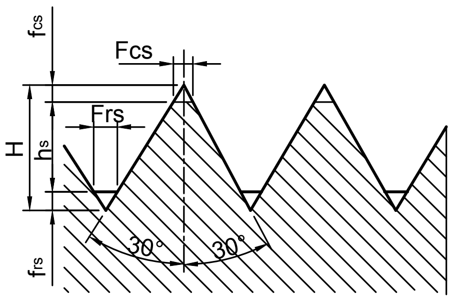


Fig. 11 Cylinder and Valve Neck Dimensions



WHERE
d = BASIC MAJOR DIAMETER OF EXTERNAL THREAD (NOMINAL DIAMETER)
d1 = BARIC MINOR DIAMETER OF EXTERNAL THREAD
d2 = BASIC PITCH DIAMETER OF EXTERNAL THREAD
H = HEIGHT OF FUNDAMENTAL TRIANGLE
P = PITCH

FIG. 12a THREAD PROFILE FOR METRIC THREAD - EXTERNAL



THE FOLLOWING FORMULA APPLIES FOR CALCULATING THE BASIC DIMENSIONS: P = 25.4/ n

WHERE,
n = NUMBER OF THREADS PER THE LENGTH (25.4 mm)
H = 0.866025P
h_S = 0.64952P
f_{CS} = 0.10825P
f_{rs} = 0.10825P
F_{CS} = 0.12500P
F_{rs} = 0.12500P
P = PITCH

FIG. 12b THREAD PROFILE FOR NPSM THREAD - EXTERNAL

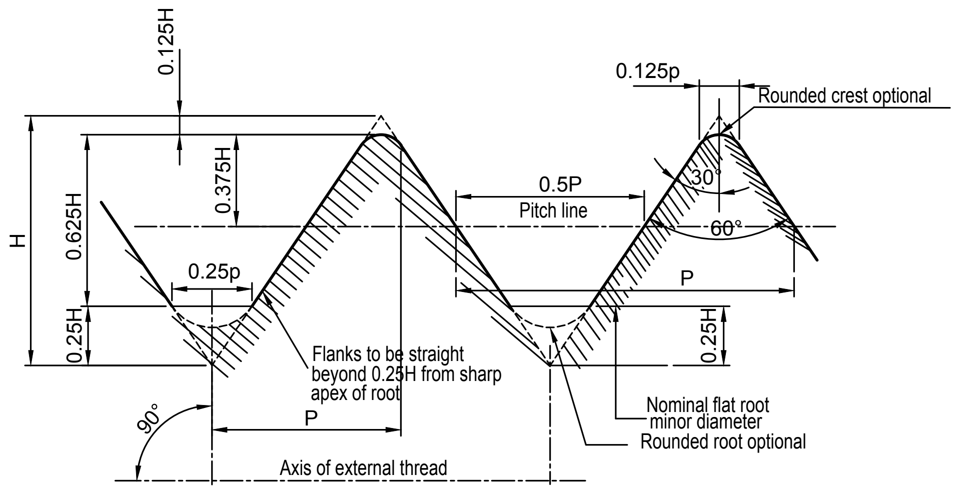


FIG. 12c THREAD PROFILE FOR UNF THREAD - EXTERNAL

FIG. 12 THREAD PROFILE

Table 10 Dimensions of Oversized Valve Inlets for Type 1 Inlet Threads

(*Clause* 8.2.1)

All dimensions in millimetres

Sl No.	Thread Designation	Hand Tight Engagement	External Threads (on Valve Stem)							Internal Threads (in cylinder neck)					
			Small end			Full threads		Large end		Pitch Dia at Face E_1	Counter 90° x Max Dia	Full threads			
			Major dia	Pitch dia	Chamfer 45° x Min Dia	Pitch dia	Length	Major dia	Overall length			Bore Max	Pitch Dia	Length $L_1 + L_3$	Length of Full Root
		L_1	D_0	E_0		E_8	L_8	D_{10} Approx	L_{10} Approx			K_3	E_3		Min L_9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
i)	3/4 - 14 NGT (Cl) – 1	8.611	26.030	24.580	23.0	26.081	24.031	27.8	28.5	25.118	27.0	22.789	24.239	14.054	24.031
ii)	3/4 - 14 NGT (Cl) – 2 (4 turns oversize)	8.611	26.484	25.034	23.4	26.535	24.031	28.3	28.5	*See* Note 2					
iii)	3/4 - 14 NGT (7 turns oversize)	8.611	26.824	25.374	23.7	26.875	24.031	28.6	28.5						
iv)	3/4 - 14 NGT (Cl) – 3 (8.1/2 turns oversize)	8.611	26.995	25.545	23.8	27.046	24.031	28.8	28.5						
v)	3/4 - 14 NGT (Cl) – 4 (14 turns oversize)	8.611	27.617	26.167	24.6	27.668	24.031	29.4	28.5						

NOTES

1 For uses other than chlorine, oversized threads for re-valving are generally specified at 4 turns [$^3/_4$ – 14 NGT (Cl)–2] and 7 turns oversize. For chlorine, the $^3/_4$ – 14 NGT(Cl)–1 size is standard, $^3/_4$ – 14 NGT(Cl) – 2 is 4 turns oversize, $^3/_4$ – 14 NGT(Cl) – 3 is $8^1/_2$ turns oversize and $^3/_4$ – 14 NGT(Cl) – 4 is 14 turns oversize.

2 External (CL) – 2 through (CL) – 4 threads are provided for new valves installed in used cylinders. Therefore (CL) – 2 through (CL) – 4 threads do not apply to internal threads table.

Table 11 Dimensions of Oversized Valve Inlet for Type 4 Inlet Threads

(*Clause* 8.2.2)

All dimensions are in millimeters

Sl No.	Size Designation	Nominal Size	Designation of Oversize	No. of Turns Oversize	Stem Major Diameter (A)	Taper on Diameter	Pitch Measured Along The Cone	Length of Thread (B+3.170)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Size 1	18.16	1st oversize	3.5	18.954	1 in 8	1.814	22.23
			2nd oversize	7	19.747			
			3rd oversize	10.5	20.541			
			4th oversize	14	21.334			
ii)	Size 2	25.4	1st oversize	3.5	26.194	1 in 8	1.814	25.4
			2nd oversize	7	26.987			
			3rd oversize	10.5	27.781			
			4th oversize	14	28.574			
iii)	Size 3	31.75	1st oversize	2.75	32.544	1 in 8	2.309	31.75
			2nd oversize	5.5	33.337			
			3rd oversize	8.25	34.131			
			4th oversize	11	34.925			

9 OUTLET CONNECTIONS

9.1 There are broadly two types of outlet connection either having internal threads or external threads.

9.1.1 The dimension of the valve outlet having external or internal threads shall be in conformity with the details given in Table 1 and outlet connection listed in this clause. Outlets for gas mixtures shall be decided in consultation with and approval of statutory authority.

NOTES

1 Internal/external threads as shown in the drawing may be without undercut provided minimum length of full threads in the outlet drawing is as specified.

2 *see* Annex C regarding thread code for outlet connection.

9.1.2 Any hexagon with a left-hand thread on valve outlet and any hexagonal nut with a left-hand thread shall have notches on the corners for easy identification of the direction of thread.

9.1.3 The dimension for connectors, washers and nuts shall be in accordance with the details given for appropriate outlet. These connectors, washers, nuts are not part of the valve.

10 VALVE DESIGN QUALIFICATION TESTS (TYPE TESTS)

10.1 To comply with this standard cylinder valves shall be type tested. A type test is valid for a given valve design (*see* **4.2**). Unless otherwise stated, all tests shall be performed at room temperature. For all tests PRD will be removed unless mentioned otherwise.

10.1.1 The number of samples required for type testing a valve design is given in Table 3.

10.1.2 Material variants within a valve design, for example, for reasons of compatibility between gas and non-metallic material require repetition of only the relevant parts of the type test, using a reduced number of test samples for the tightness and endurance test. Additional test samples might be required for changes or for material variants within the valve design (*see* Table 18).

10.1.3 Examples of components which might constitute material variants include:

a) O-ring;
b) Back-up ring;
c) Diaphragm;
d) Packing;
e) Seat insert;
f) Lubricant;
g) Spring;
h) Thrust washer; and
j) Gasket.

10.1.4 Some changes within the valve design qualified to this standard which could adversely affect valve performance require qualification tests to be repeated using the number of samples quoted in Table 3.

Table 12 Cylinder and Valve Neck Dimension

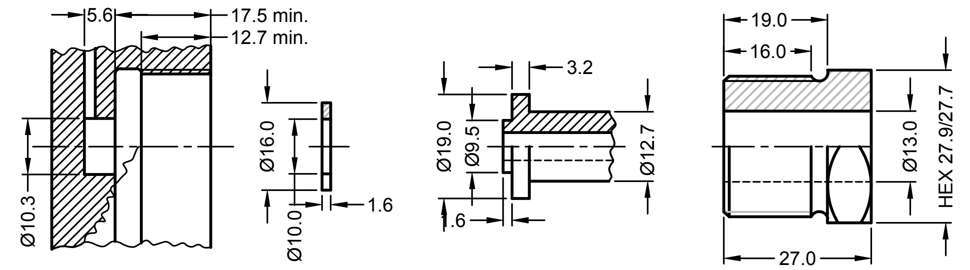
(*Clauses* 8.3.1 *and* 8.3.2)

All dimensions are in millimeters

Sl No.	Thread Size	Valve Inlet Dimension			Z	ØY, *MIN*	V, MIN	Cylinder Neck Dimension					O-Ring Dimension	
		X						ΦB	ΦC	F	E	D, *MIN*	I.D	t $^{(\pm 0.10)}$
		Major DIA	*Pitch DIA*	*Minor DIA, MAX*										
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
i)	M18 × 1.5-6g	17.732 – 17.968	16.854–16.994	16.128	22 to 24	28	2.50	23.66–23.83	$18.0^{+0.63/+0.33}$	$1.90^{+0.40/-0.0}$	$5.5^{\pm 0.50}$	24.0	$\Phi 17.86^{\pm 0.21}$	2.62
ii)	M25 × 2.0-6g	24.682–24.962	23.493–23.663	22.508	25 to 27	35		32.28–32.53	$25.0^{+0.63/+0.33}$	$2.70^{+0.50/-0.0}$	$6.5^{\pm 0.50}$	27.0	$\Phi 25.00^{\pm 0.25}$	3.53
iii)	M30 × 2.0-6g	29.682–29.962	28.493–28.663	22.508	25 to 30	43		37.28–37.53	$30.0^{+0.63/+0.33}$	$2.70^{+0.50/-0.0}$	$8.0^{\pm 0.50}$	30.0	$\Phi 29.75^{\pm 0.29}$	3.53
iv)	1 ⅛ 12 UNF-2A	28.240–28.529	27.003–27.155	26.01	24.0 MIN	38	3.50	35.39–35.53	$28.96^{\pm 0.12}$	$2.70^{+0.50/-0.0}$	$6.35^{\pm 0.12}$	18.95	$\Phi 28.17^{\pm 0.30}$	3.53
v)	¾–16 UNF-2A	18.773–19.012	17.854–17.981	17.012	19.0 MIN	30		25.79–25.93	$19.43^{\pm 0.12}$	$2.70^{+0.50/-0.0}$	$4.80^{\pm 0.12}$	14.20	$\Phi 18.64^{\pm 0.25}$	3.53
vi)	¾–14 NPSM	26.010–26.264	24.943–25.077	23.908	24.0 MIN	35		33.25–33.39	$26.30^{\pm 0.12}$	$2.70^{+0.50/-0.0}$	$6.35^{\pm 0.12}$	24.0	$\Phi 24.99^{\pm 0.25}$	3.53

NOTE — If other Dimensions and tolerances are used, it shall be verified by the valve manufacturer that performance (for example, compression set, fill factor) is not compromised.

OUTLET CONNECTION FIGURES



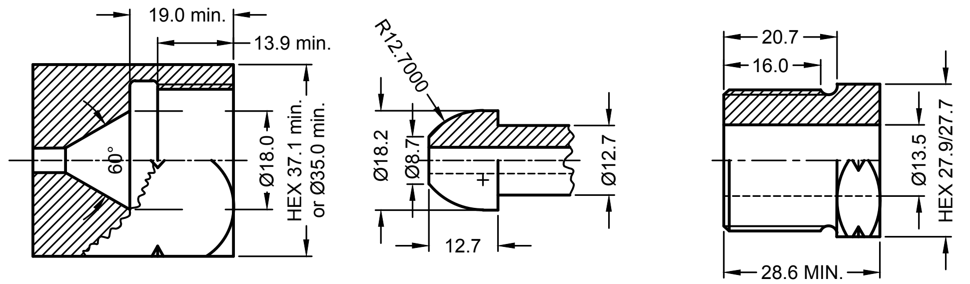
VALVE OUTLET | WASHER | CONNECTOR | HEXAGON NUT

THREAD G3/4-14 TPI-RH (BSP 3/4)
MINOR DIA 24.658/24.117
PITCH DIA 25.421/25.279
MAJOR DIA 26.441, MIN

THREAD G3/4A-14 TPI-RH (BSP 3/4)
MAJOR DIA 26.441/26.157
PITCH DIA 25.279/25.137
MINOR DIA 24.117, MAX

All dimensions in millimetres

OUTLET NO. 1 OUTLET CONNECTION FOR ACETYLENE (MARINE LIGHTING INSTALLATIONS)



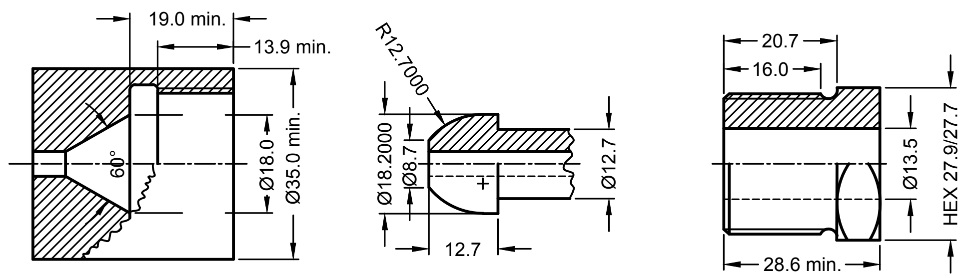
VALVE OUTLET | CONNECTOR | HEXAGON NUT

THREAD G5/8-14 TPI-LH (BSP 5/8)
MINOR DIA 21.128/20.587
PITCH DIA 21.891/21.749
MAJOR DIA 22.911, MIN

THREAD G5/8A-14 TPI-LH (BSP 5/8)
MAJOR DIA 22.911/22.627
PITCH DIA 21.746/21.607
MINOR DIA 20.587, MAX

All dimensions in millimetres

OUTLET NO. 2 OUTLET CONNECTION FOR ACETYLENE, BUTADIENE, CARBON MONOXIDE, COAL GAS, ETHYLENE, HYDROGEN, METHENE, DIMETHYL ETHER AND ISOBUTYLENE



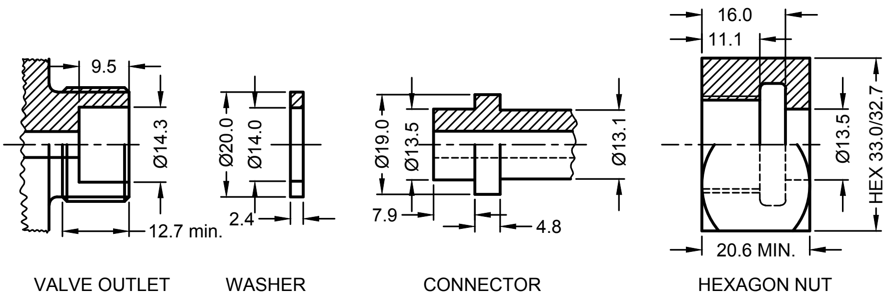
VALVE OUTLET | CONNECTOR | HEXAGON NUT

THREAD G5/8-14 TPI-RH (BSP 5/8)
MINOR DIA 21.128/20.587
PITCH DIA 21.891/21.749
MAJOR DIA 22.911, MIN

THREAD G5/8A-14 TPI-RH (BSP 5/8)
MAJOR DIA 22.911/22.627
PITCH DIA 21.746/21.607
MINOR DIA 20.587, MAX

All dimensions in millimetres

OUTLET NO. 3 OUTLET CONNECTION FOR OXYGEN

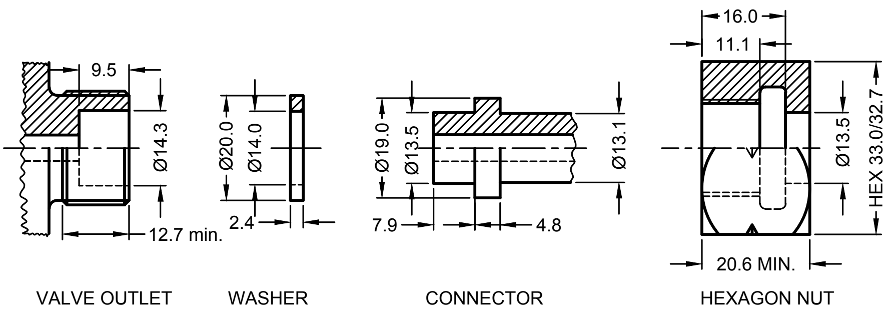


THREAD G5/8A-14 TPI-RH (BSP 5/8)
MAJOR DIA 22.911/22.627
PITCH DIA 21.746/21.607
MINOR DIA 20.587, MAX

All dimensions in millimetres

THREAD G5/8-14 TPI-RH (BSP 5/8)
MINOR DIA 21.128/20.587
PITCH DIA 21.891/21.746
MAJOR DIA 22.911, MIN

OUTLET NO. 5 OUTLET CONNECTION FOR CHLORINE, CHLORINE TRIFLUORIDE, CHLORODIFLUOROMETHANE, CHLOROTRIFLUOROMETHENE, DICHLORODIFLUOROMETHANE, DICHLOROFLUOROMETHANE, HYDROGEN CHLORIDE, HYDROGEN FLUORIDE, PHOSGENE, SULPHUR HEXAFLUORIDE, TRICHLOROFLUOROMETHANE AND BORON TRIFLUORIDE

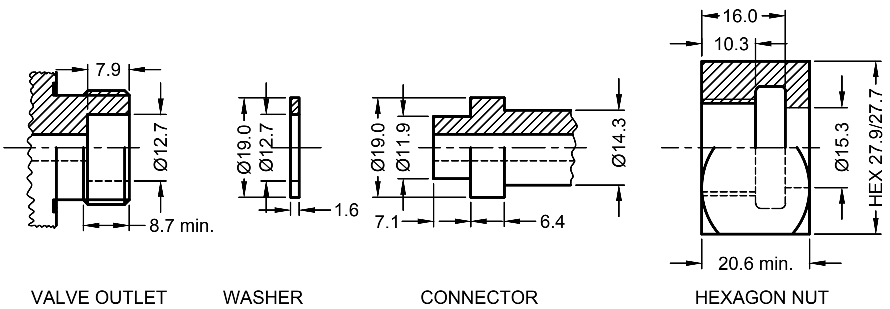


THREAD G5/8A-14 TPI-LH (BSP 5/8)
MAJOR DIA 22.911/22.627
PITCH DIA 21.746/21.607
MINOR DIA 20.587, MAX

All dimensions in millimetres

THREAD G5/8-14 TPI-LH (BSP 5/8)
MINOR DIA 21.128/20.587
PITCH DIA 21.891/21.749
MAJOR DIA 22.911, MIN

OUTLET NO. 6 OUTLET CONNECTION FOR DIMETHYLAMINE, ETHYL CHLORIDE, ETHYLENE OXIDE, METHYLE CHLORIDE, TRIMETHYLAMINE AND VINYL CHLORIDE

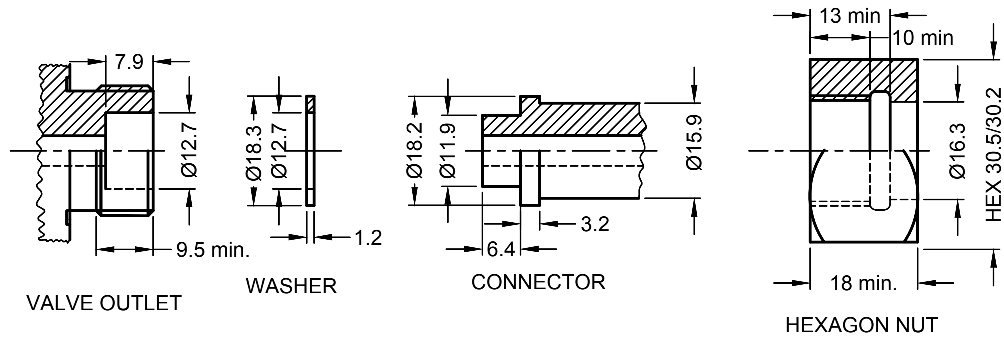


THREAD EXT-W21.8 X 1.814-RH
(BSW 0.860-14TPI)
PITCH 1.814
MAJOR DIA 21.844/21.613
PITCH DIA 20.683/20.526
MINOR DIA 19.522/19.218

All dimensions in millimetres

THREAD INT-W21.8 X 1.814-RH
(BSW 0.860-14TPI)
PITCH 1.814
MINOR DIA 20.124/19.522
PITCH DIA 20.841/20.683
MAJOR DIA 21.844, MIN

OUTLET NO. 7 OUTLET CONNECTION FOR CARBON DIOXIDE

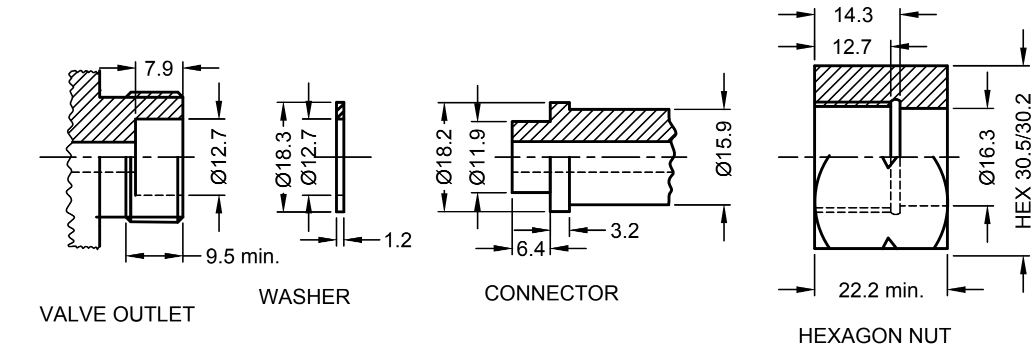


THREAD G1/2A-14 TPI-RH (BSP 1/2)
MAJOR DIA 20.955/20.671
PITCH DIA 19.793/19.651
MINOR DIA 18.631, MAX

THREAD G1/2-14 TPI-RH (BSP 1/2)
MINOR DIA 19.172/18.631
PITCH DIA 19.935/19.793
MAJOR DIA 20.955, MIN

All dimensions in millimetres

OUTLET NO. 9 OUTLET CONNECTION FOR AMMONIA

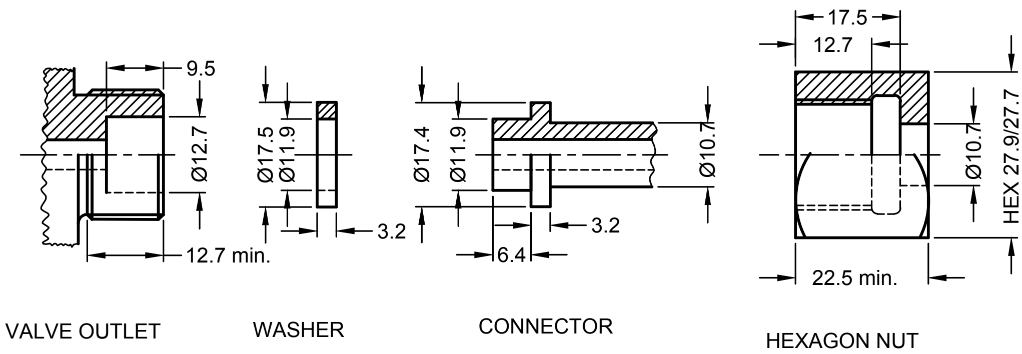


THREAD G1/2A-14 TPI-LH (BSP 1/2)
MAJOR DIA 20.955/20.671
PITCH DIA 19.793/19.651
MINOR DIA 18.631, MAX

THREAD G1/2-14 TPI-LH (BSP 1/2)
MINOR DIA 19.172/18.631
PITCH DIA 19.935/19.793
MAJOR DIA 20.955, MIN

All dimensions in millimetres

OUTLET NO. 10 OUTLET CONNECTION FOR ETHYLAMINE AND METHYLAMINE

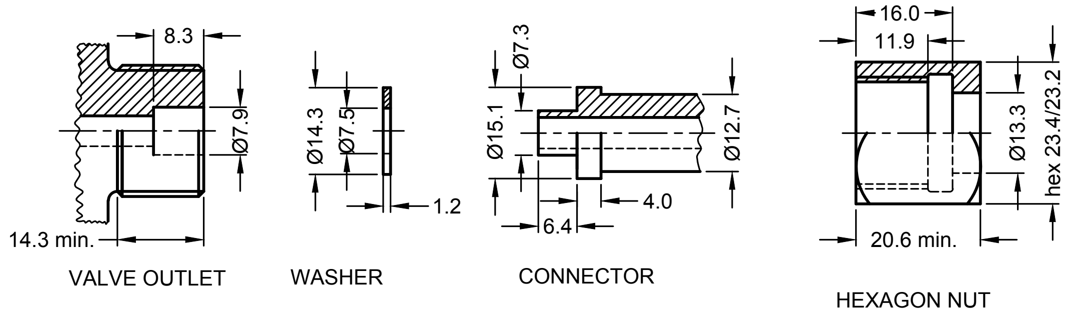


THREAD G1/2A-14 TPI-RH (BSP 1/2)
MAJOR DIA 20.955/20.671
PITCH DIA 19.793/19.651
MINOR DIA 18.631, MAX

THREAD G1/2-14 TPI-RH (BSP 1/2)
MINOR DIA 19.172/18.631
PITCH DIA 19.935/19.793
MAJOR DIA 20.955, MIN

All dimensions in millimetres

OUTLET NO. 11 OUTLET CONNECTION FOR SULPHUR DIOXIDE



THREAD EXT-W17.42 X 1.27-RH
(BSW 11/16-20TPI)

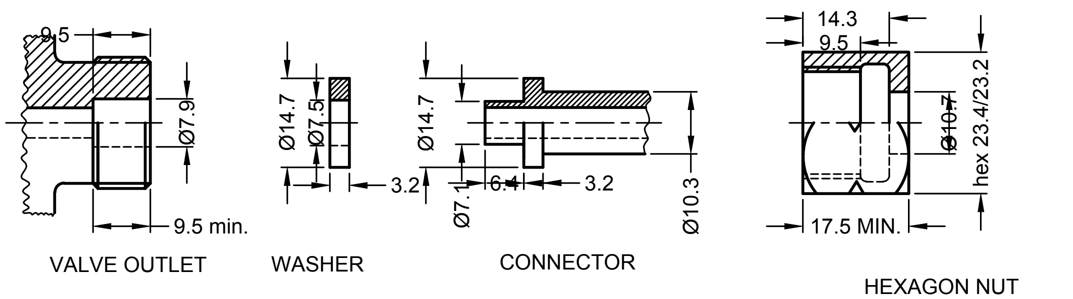
MAJOR DIA 17.424/17.247
PITCH DIA 16.611/16.490
MINOR DIA 15.799/15.563

THREAD INT-W17.42 X 1.27-RH
(BSW 11/16-20TPI)

MINOR DIA 16.269/15.837
PITCH DIA 16.772/16.650
MAJOR DIA 17.450, MIN

All dimensions in millimetres

OUTLET NO. 12 OUTLET CONNECTION FOR NITROUS OXIDE



THREAD G3/8A-19 TPI-LH (BSP 3/8)

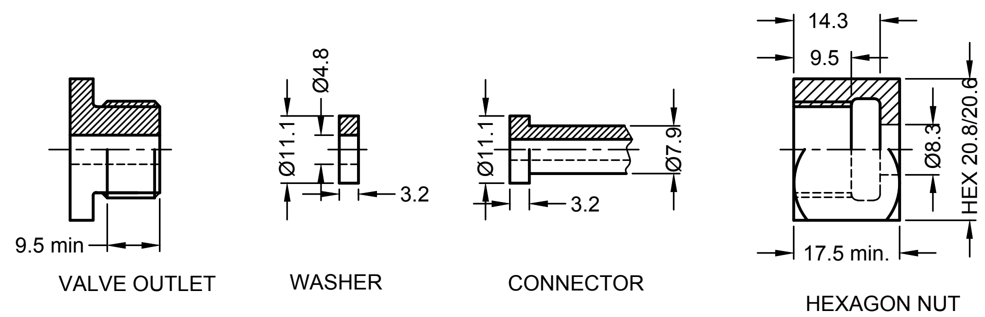
MAJOR DIA 16.662/16.412
PITCH DIA 15.806/15.681
MINOR DIA 14.950, MAX

THREAD G3/8-19 TPI-LH (BSP 3/8)

MINOR DIA 15.395/14.950
PITCH DIA 15.931/15.806
MAJOR DIA 16.662, MIN

All dimensions in millimetres

OUTLET NO. 14 OUTLET CONNECTION FOR HYDROGEN SULPHIDE



THREAD G1/4A-19 TPI-RH (BSP 1/4)

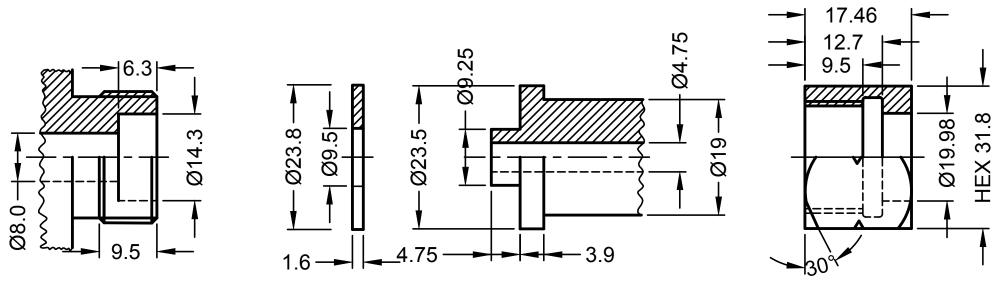
MAJOR DIA 13.157/12.907
PITCH DIA 12.301/12.176
MINOR DIA 11.445,MAX

THREAD G1/4-19 TPI-RH (BSP 1/4)

MINOR DIA 11.890/11.445
PITCH DIA 12.426/12.301
MAJOR DIA 13.157, MIN

All dimensions in millimetres

OUTLET NO. 15 OUTLET CONNECTION FOR METHYL BROMIDE



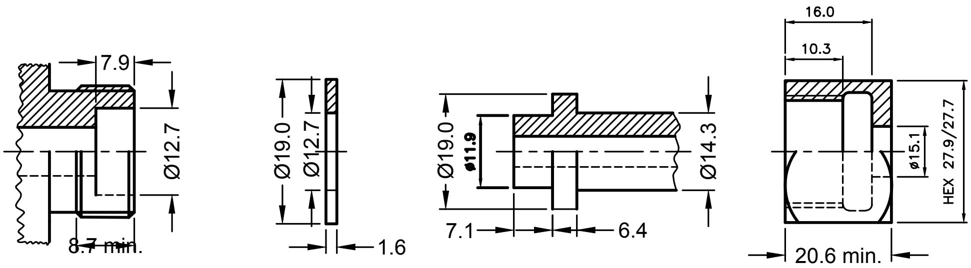
VALVE OUTLET WASHER CONNECTOR HEXAGON NUT

THREAD G3/4A-14 TPI-LH (BSP 3/4)
MAJOR DIA 26.441/26.157
PITCH DIA 25.279/25.137
MINOR DIA 24.117,MAX

THREAD G3/4-14 TPI-LH (BSP 3/4)
MINOR DIA 24.658/24.117
PITCH DIA 25.421/25.279
MAJOR DIA 26.441, MIN

All dimensions in millimetres

OUTLET NO. 17 OUTLET CONNECTION FOR HYDROGEN CYANIDE, CYNOGEN



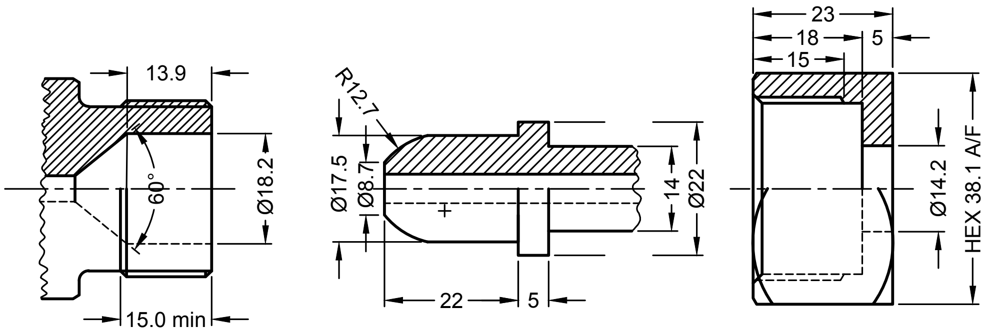
VALVE OUTLET Washer CONNECTOR HEXAGON NUT

THREAD EXT M22 X 1.5P-RH
MAJOR DIA 21.968/21.732
PITCH DIA 20.994/20.854
MINOR DIA 20.128/19.880

THREAD INT M22 X 1.5P-RH
MINOR DIA 20.676/20.376
PITCH DIA 21.216/21.026
MAJOR DIA 22.000 MIN

All dimensions in millimetres

OUTLET NO. 18 OUTLET CONNECTION FOR BROMOCHLORO DIFLUORO METHANE (HALON 1211) AND BROMOFLUORO METHANE (HALON 1301)



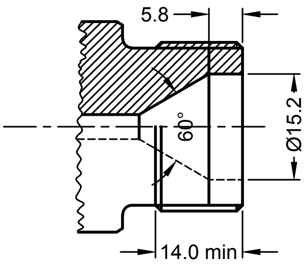
VALVE OUTLET CONNECTOR HEXAGON NUT

THREAD G7/8A-14 TPI-RH (BSP 7/8)
MAJOR DIA 30.201/29.917
PITCH DIA 29.039/28.755
MINOR DIA 27.887, MAX

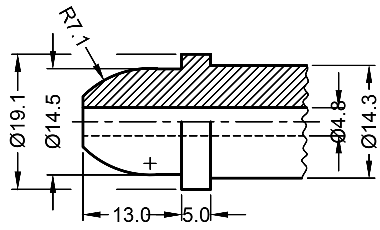
THREAD G7/8-14 TPI-RH (BSP 7/8)
MINOR DIA 28.418/27.877
PITCH DIA 29.181/29.039
MAJOR DIA 30.201, MIN

All dimensions in millimetres

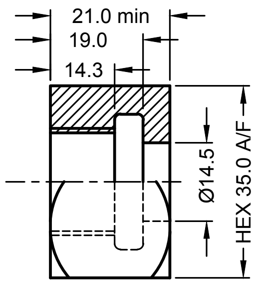
OUTLET NO. 19 OUTLET CONNECTION FOR AIR



VALVE OUTLET



CONNECTOR



HEXAGON NUT

THREAD G3/4A-14 TPI-RH (BSP 3/4)

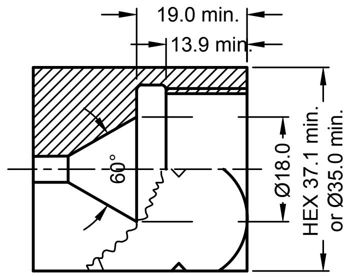
MAJOR DIA 26.441/26.157
PITCH DIA 25.279/25.137
MINOR DIA 24.117, MAX

THREAD G3/4-14 TPI-RH (BSP 3/4)

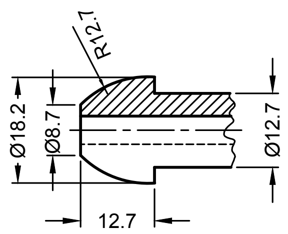
MINOR DIA 24.658/24.117
PITCH DIA 25.421/25.279
MAJOR DIA 26.441, MIN

All dimensions in millimetres

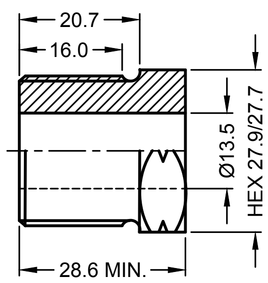
OUTLET NO. 20 OUTLET CONNECTION FOR ARGON, NITROGEN, HELIUM, NEON, KRYPTON AND XENON



VALVE OUTLET



CONNECTOR



HEXAGON NUT

THREAD G5/8-14 TPI-LH (BSP 5/8)

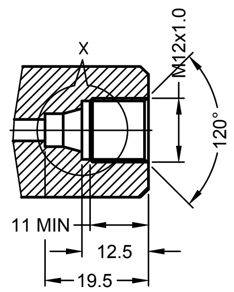
MINOR DIA 21.128/20.587
PITCH DIA 21.891/21.749
MAJOR DIA 22.911, MIN

THREAD G5/8A-14 TPI-LH (BSP 5/8)

MAJOR DIA 22.911/22.627
PITCH DIA 21.746/21.607
MINOR DIA 20.587, MAX

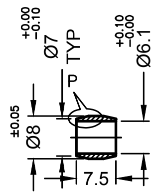
All dimensions in millimetres

OUTLET NO. 21 OUTLET CONNECTION FOR COMPRESSED NATURAL GAS

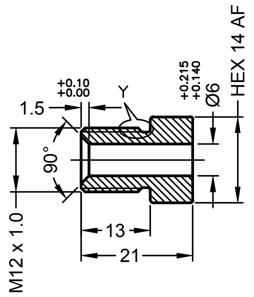


VALVE OUTLET

THREAD INT-M12 X 1P-RH
MINOR DIA 11.153/10.917
PITCH DIA 11.510/11.350
MAJOR DIA 12.304/12.000

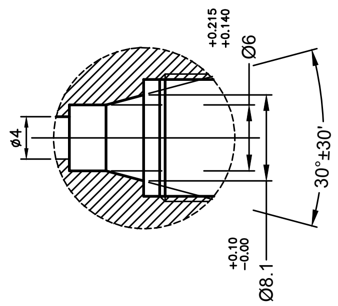


FERRULE

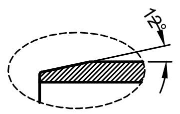


HEXAGON NUT

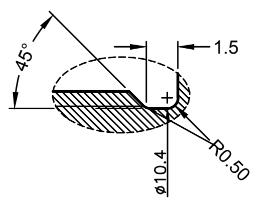
THREAD EXT-M12 X 1P-RH
MAJOR DIA 11.974/11.794
PITCH DIA 11.324/11.206
MINOR DIA 10.891/10.590



ENLARGED VIEW OF X



ENLARGED VIEW OF P



ENLARGED VIEW OF Y

ALL DIMENSIONS IN MILLIMETRES

OUTLET NO. 21(A) OUTLET CONNECTION FOR COMPRESSED NATURAL GAS

NOTES

1 Reduced number of samples may be taken, depending upon the change in consultation with the inspection agency.

2 Flow capacity of the PRD will only be repeated in case of change in PRD design and/or change in internal gas passage from valve inlet connection to the inlet of the PRD.

10.1.5 These changes can involve but are not limited to modifications to the valve components (for example, O-ring, packing, diaphragm, spindle, lubricant, material for valve body or characteristics (changes affecting flow path, inlet size or internal components). Changes with tests to be repeated include:

a) *Increase of Valve Working Pressure* — Repeat of valve burst pressure test, endurance test and subsequent leak tightness test;

b) *Change in Gas Service* — The compatibility between each new gas and gas mixture and the used materials shall be verified;

c) *Changes of the Valve Body Material* — Repetition of any tests to be decided case by case depending on changes of the chemical composition and mechanical properties with prior approval of Statutory Authority;

NOTE — It is recognized that change in chemical composition of valve body material from one grade of brass to another grade of brass or from one grade of steel to another grade of steel will not require repeat of the endurance test.

d) *Changes of the Hand Wheel Material* — Repetition of the excessive torque tests and flame impingement tests;

e) *Changes of the Hand Wheel Diameter* — Repetition of the endurance test and subsequent leak tightness test and excessive torque test;

f) *Changes of the Valve Internal Sealing System, for Example, Non-Metallic Seal and Metal to Metal Seal* **—** Repetition of all tests except valving torque test and valve impact test;

g) *Changes of the Basic Design Dimensions of the Valve Components (For Example, Bottom Spindle Diameter, Spindle Thread Pitch, Seat Diameter, Dimensions of the O-Ring(S), Diaphragm Thickness and Flow Path* — Repetition of tests to be decided case by case depending on the change and with prior approval of Statutory Authority;

h) *Changes in Material of Valve Internal or External Sealing System (for Example Change in One Type of Non-metallic Seal to Another Type of Non-metallic Seal)* — Repetition of endurance test;

j) *Changes of Metallic Material of the Valve Operating Mechanism Components (for Example, Gland nut, Spindle, Diaphragms, Springs*) — Repetition of tests to be decided case by case depending on the change;

k) *Variations to Outlet Connections do not Require Further Type Testing*;

m) *Additions to Inlet Connections* — Repetition of valve impact test and valving torque test;

n) *Change/Integration of PRD (except for CNG valves)* — Repetition of only flow capacity of PRD;

NOTE — PRD design for CNG valve already qualified/approved to this standard may be transferred to another valve design qualified/approved for the same Working Pressure(s) by verifying the flow capacity of the PRD without repeat of any PRD design qualification tests given (*see* 11).

p) *Changes in PRD Design Used for CNG Valves* — Repetition of PRD design qualification tests (*see* **11**) and test for flow capacity of PRD;

q) Removal of a pressure relief device will not require any tests to be repeated. Integration of a pressure relief device will require repetition of hydraulic burst pressure test and impact test (if required) only.

r) Changes of the O-ring material of a valve parallel inlet connection (repetition of impact test).

10.2 Drawing

Assembly drawing for a given valve design shall include the following details:

a) Design classification;

b) Part list and material specification;

c) Variants within a valve design;

d) Gas service and corresponding valve working pressure (P_w);

e) Lubricants, if used in the valve;

f) Inlet sizes;

g) Outlet sizes and gas services;

h) Minimum closing torque (T_c);

j) Endurance torque at start ($T_{e,\ start}$) for metal to metal seat valve;

k) Pressure relief device (PRD) details, if provided;

m) In case valves are equipped with PRD — The maximum water capacity (W_c) for permanent gas and liquefied gas for which the design is intended; and

n) Excess flow valve (for CNG valves), if provided.

10.3 Test Pressures

10.3.1 *Valve Burst test Pressure (P_{vbt})*

For compressed gases:

$$P_{vbt} = 1.5 \times 1.5\ P_w$$

For liquefiable/Dissolved gases:

$$P_{vbt} = 1.5 \times P_w$$

10.3.2 *Valve test pressure (P_{vt})*

For compressed gases:

$$P_{vt} = 1.2 \times P_w$$

For liquefiable gases and dissolved gases

$$P_{vt} \geq P_w$$

10.4 Mechanical Strength

10.4.1 *Hydraulic Burst Pressure Test*

One sample shall be tested. The burst pressure test shall be carried out with the valve seat in open position (valve outlet/filling connection(s) plugged. Valves equipped with actuators shall be opened according to the manufacturer's specification.

Water or another suitable liquid shall be used as test medium. The hydraulic pressure shall be applied via the inlet connection and be raised continuously and gradually until at least P_{vbt} is reached. The pressure shall be maintained for at least 2 min.

The test sample shall withstand the P_{vbt} without permanent visible deformation or burst.

NOTE — For the test in closed position it is permissible for the valve to leak through the seat at a pressure above P_{vt} but below P_{vbt} provided no parts are ejected.

10.4.2 *Resistance to Mechanical Impact (Valve Impact Test)*

10.4.2.1 One sample shall be tested from each category covered in the drawing to qualify all the other inlet sizes (and their respective oversize's) in that category. Valve designs that have a smaller bore size than the tested sample also are qualified in accordance with this test.

10.4.2.2 The purpose of this test is to ensure that the valve has sufficient strength to withstand impact during transport, without release of contents.

10.4.2.3 For taper threads the test sample shall be fitted using the minimum of all given torque values for the tested inlet connection (*see* Table 13 and Table 15). For parallel threads the test sample shall be fitted using the maximum of all given torque values for the tested inlet connection (*see* Table 14 and Table 16). The test sample shall be fitted into a steel gas cylinder neck equipped with the corresponding screw thread, or a similar test fixture made of steel.

10.4.2.4 It has to be verified that the threaded joint between the valve and the cylinder/test fixture does not leak before impact testing.

10.4.2.5 The test sample shall be tested in the closed condition (closed to $T_{e, start}$ in accordance with Table 2).

10.4.2.6 The test sample shall be struck by a plummet weight, tipped with a 13 mm diameter hardened steel ball. At impact the plummet weight and hardened steel ball assembly shall have a minimum velocity of 3 m/s and minimum impact energy given in Table 17.

10.4.2.7 The impact shall be at 90^{O} to the longitudinal axis of the test sample and co-incident with a plane passing through the same axis.

10.4.2.8 The point of impact shall be two-thirds of the distance, *L*, from the plane where the valve inlet connection thread meets the cylinder (cylinder top) to the furthest point of the valve body, measured along the longitudinal (valve inlet connection) axis of the valve (*see* Fig. 13).

10.4.2.9 The point of impact at that location shall not be obstructed by features such as outlet connection threads, pressure-relief devices, hand wheel, etc.

10.4.2.10 The test sample shall be struck once only.

10.4.2.11 Distortion due to impact is permissible. After being impacted, for safety reasons the closed valve shall first be pressurized hydraulically to p_{vt} before undergoing a leak tightness test at p_{vt} with the outlet unplugged. The total leakage (comprising that from the valve internal sealing system plus that from the threaded joint between the valve and the cylinder/test fixture) shall not exceed 100 cm^3/h. Any leakage shall not result from cracking of the valve body. In addition the test sample shall remain capable of being opened for emergency venting purposes by hand or by using a simple tool or actuating connector (for example, a valve key) provided the opening torque, if relevant, does not exceed T_f, (*see* Table 2).

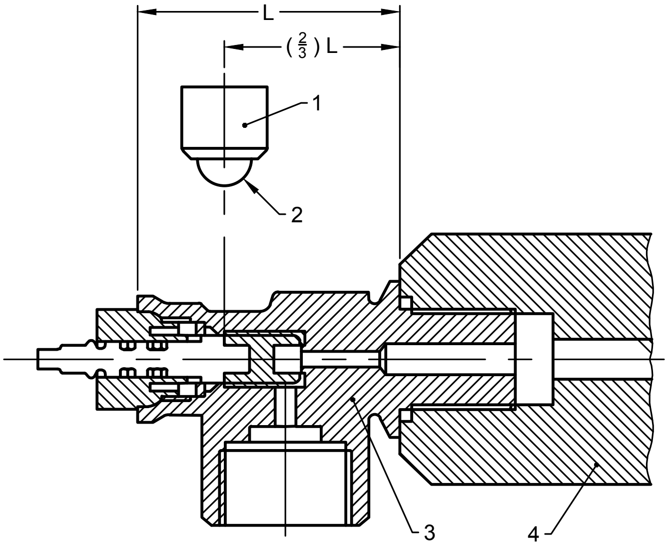
10.4.3 *Valving Torque Test*

10.4.3.1 One sample shall be tested from each category covered in the drawing to qualify all the other inlet sizes (and their respective oversize's) in that category. Valve designs that have a smaller bore size than the tested sample also are qualified in accordance with this test.

10.4.3.2 The purpose of this test is to ensure that the valve stem has adequate mechanical strength to prevent shearing during valve installation. A rigidly anchored steel test rig/bung of the same inlet thread is to be used for this test.

10.4.3.3 Threads of the cylinder neck installed on the test rig and valve test sample shall be gauged to acceptance before carrying out the test.

10.4.3.4 The test sample shall be tightened using compatible thread sealant/O-ring as applicable. Table 13 and Table 15 gives the values of recommended valving torque for valves with taper stems, Table 14 and Table 16 gives the values of recommended valving torque for valves with parallel threads.



1 - PLUMMET WEIGHT
2 - HARDEND STEEL BALL, DIAMETER 13 mm
3 - TEST SAMPLE
4 - TEST FIXTURE OR CYLINDER
a - LONGITUDINAL AXIS

FIG. 13 TYPICAL TEST RING FOR IMPACT TEST

Table 13 Recommended Valving Torques for Taper Threaded Valve Stems

(*Clauses* 10.4.2.3, 10.4.3.4 *and* 10.4.3.5)

Sl No.	Valve Material	Category	Inlet Thread Code	Valving Torque (Nm)	
				Seamless Steel Cylinders	
				Min	*Max*
(1)	(2)	(3)	(4)	(5)	(6)
i)	Copper base alloy and Carbon steel	a) I	a) 18T	120	150
			b) 08N		
			c) 17E		
		b) II	d) 25.4	200	300
			e) 12N		
			f) 25E		
		c) III	g) 32T	340	380
			h) 16N		

NOTES

1 The torque figures given above are for use with PTFE thread sealant. If different sealant or pressure ranges are introduced, the torque figures given in the table may have to be changed to ensure a gas tight joint.

2 All values shall be reduced to 2/3 of the values in the table for stainless steel valves.

Table 14 Recommended Valving Torque for Parallel Threaded Valve Stem

(*Clauses* 10.4.2.3, 10.4.3.4 *and* 10.4.3.5)

Sl No.	Valve Material	Category	Inlet Thread Code	Valving Torque – Nm	
				Min	*Max*
(1)	(2)	(3)	(4)	(5)	(6)
i)	Copper base alloy, Carbon steel and Stainless steel	a) I	a) 18P	a) 85	a) 100
			b) U12	b) 85	b) 100
		b) II	c) 25P	c) 95	c) 130
			d) SP12	d) 95	d) 130
			e) U18	e) 95	e) 130
			f) 30P	f) 95	f) 130

Table 15 Recommended Valving Torques of Taper Threaded Valve Stems for Aluminium Alloy Cylinders and Composite Cylinders with Aluminium Alloy Boss

(*Clauses* 10.4.2.3, 10.4.3.4 *and* 10.4.3.5)

Sl No.	Valve Material	Category	Inlet Thread Code	Valving Torque		
				Min Nm	*Max*	*Nm*
					Without cylinder neck reinforcement	With cylinder neck reinforcement
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Copper base alloy and Carbon steel	a) I	a) 18T	a) 75	a) 95	a) 140
			b) 08N			
			c) 17E			
		b) II	d) 25.4	b) 95	b) 110	b) 180
			e) 12N			
			f) 25E			

NOTE — The torque figures given above are for use with PTFE thread sealant. If different sealant or pressure ranges are introduced, the torque figures given in the table may have to be changed to ensure a gas tight joint.

Table 16 Recommended Valving Torque of Parallel Threaded Valve Stem for Aluminium Alloy Cylinders and Composite Cylinders with Aluminium Alloy Boss

(*Clauses* 10.4.2.3, 10.4.3.4 *and* 10.4.3.5)

Sl No.	Valve Material	Category	Inlet Thread Code	Valving Torque – Nm	
				Min	*Max*
(1)	(2)	(3)	(4)	(5)	(6)
i)	Copper base alloy, Carbon steel and Stainless steel	a) I	a) 18P	a) 85	a) 100
			b) U12		
		b) II	c) 25P	b) 95	b) 130
			d) SP12		
			e) U18		
			f) 30P		

Table 17 Required Impact Energy for Inlet Stems

(*Clause* 10.4.2.6)

Sl No.	Category	Inlet Thread Code	Thread Type	Joule
(1)	(2)	(3)	(4)	(5)
i)	a) I	a) 08N b) 17E c) 18T	a) Taper	a) 80
ii)	b) II	d) 12N e) 25E f) 25.4	b) Taper	b) 200
iii)	c) III	g) 16N h) 32T	c) Taper	c) 300
iv)	d) IV	j) 18P k) U12	d) Parallel	d) 80
v)	e) V	m) 25P n) SP12 o) U18 p) 30P	e) Parallel	e) 100

10.4.3.5 Test sample shall be subjected to over torque value that is 50 percent in excess of the maximum torque value given in Table 13, Table 14, Table 15 and Table 16.

10.4.3.6 There shall be no sign of cracking or permanent deformation of the valve body or cracking of the valve stem. Deformation of the valve stem thread is acceptable.

10.4.4 *Excessive Torque Test*

10.4.4.1 *General*

Four samples shall be used for this test. The purpose of this test is to check that the valve operating mechanism has adequate strength and fails safely if subjected to excessive torque.

10.4.4.2 *For Hand-wheel operated valves*

10.4.4.2.1 A closing torque on one test sample shall gradually be increased to T_o according to Table 2. At T_o the valve shall be able to work without noticeable difficulties. It shall not show any damage or failure of any component of the valve operating mechanism and/or valve operating device. This shall be checked by visual examination after dismantling the valve.

10.4.4.2.2 To determine T_f a closing torque on a different test sample than used for the determination of T_o shall gradually be increased slowly until failure of any part of the valve operating mechanism or valve operating device occurs.

10.4.4.2.3 After this test, the valve operating mechanism may be severely damaged and not operable. Mechanical failure shall be in a manner that will not result in ejection of valve components. This shall be checked by visual examination.

10.4.4.2.4 This test shall then be repeated on two other test samples under the same conditions but applying an opening torque instead of a closing torque.

10.4.4.2.5 The value of T_f determined from applying a closing and an opening torque shall be not less than the value given in Table 2.

10.4.4.3 *Key/Toggle Operated Valves*

10.4.4.3.1 For key/toggle operated valves T_f first shall be determined using two test samples. To determine T_f a closing torque on one test sample and an opening torque on a second test sample shall gradually be increased slowly until failure of any part of the valve operating mechanism or operating device occurs.

10.4.4.3.2 After this test, the valve operating mechanism may be severely damaged and not operable. Mechanical failure shall be in a manner that will not result in ejection of valve components. This shall be checked by visual examination.

10.4.4.3.3 Then T_o shall be calculated on the basis of the lowest of these two failure torque values using the formula given in Table 2. This value of T_o shall be applied on the other two other test samples then used for determination of T_f, in closing and opening direction.

10.4.4.3.4 At T_o the valve shall be able to work without noticeable difficulties, it shall not show any damage or failure or any component of the valve operating mechanism and/or valve operating device. This shall be checked by visual examination after dismantling the valve.

10.5 Leak Tightness Test

10.5.1 *General*

Minimum of five samples will be tested. Additional samples may be required to cover more than two variants within a valve design. The test shall be conducted with oil free dry air, nitrogen or any inert gas.

Each internal and external leak tightness test temperature sequence (*see* Table 3) shall comprise the test pressures as given in Table 4 in increasing order for room and high temperature and decreasing order for – 20 °C test.

NOTES

1 The order is chosen to reflect normal cylinder operations.

2 Prior to the test the valves shall achieve the relevant test temperature as given in Table 3 and shall be maintained at that temperature throughout the complete test procedure. After the valves are tested at low temperatures allow the test samples to naturally come to room temperature before applying high temperature to avoid temperature shocks between tests.

10.5.2 *Internal Leak Tightness Test*

The test shall be carried out in the following order:

a) Seal valve outlet connection(s);
b) Open the valve;
c) The pressure shall be applied to the valve inlet and be raised until the test pressure is reached;
d) Close the valve to the closing torque. For the leak tightness test carried out before the endurance test, the closing torque is T_c. For the leak tightness test carried out after the Endurance test, the closing torque required to achieve tightness shall not be greater than $T_{e.end}$;
e) Open the valve outlet connection; and
f) Wait at least 1 min before measuring the seat leakage rate.

NOTE — Some valve designs require extended time before measuring the leak due to trapped air in the non gas wetted area.

The internal leakage rate shall not exceed the rate specified in **6.6.1**. This test sequence shall be repeated for each test pressure given in Table 4. Before applying the next test pressure it is allowed to vent the cylinder valve.

NOTE — For valve designs which do not use torque to open and close the valve, the valve shall be opened and closed as per manufacturer's specification.

10.5.3 *External Leak Tightness Test*

The test shall be carried out in the following order:

a) Seal valve outlet connection(s);
b) Fully open the valve;
c) The pressure shall be applied to the valve inlet and be raised until the test pressure is reached;
d) Wait at least one minute before measuring the total leakage rate;
e) In addition, except for diaphragm gland seal valve, the leakage rate shall be determined with the valve operating mechanism in two intermediate positions (for example approximately 2/3 and 1/3 of the 'fully open' position; and
f) Wait at least 1 min before measuring the seat leakage rate.

NOTE — Some valve designs require extended time before measuring the leak due to trapped air in the non gas wetted area.

The external leakage rate shall not exceed the rate specified in **6.6.2**.

This test sequence shall be repeated for each test pressure given in Table 4. Before applying the next test pressure it is allowed to vent the cylinder valve.

10.6 Endurance Test

10.6.1 *General*

10.6.1.1 Samples subjected to leak tightness test (*see* **10.5**) shall be used for endurance test.

10.6.1.2 An endurance test of 2 000 cycles (opening and closing) shall be carried out using T_e as given in Table 2 at P_{vt}. The Valve inlet shall remain pressurized to P_{vt} throughout the entire test. The valve outlet shall be connected to a venting device that remains closed during the closing and opening position of the cycle. After each closure, by opening the venting device, the pressure downstream of the valve seat shall be released to atmosphere to reach atmospheric pressure.

10.6.1.3 For hand wheel operated valve, the valve may be tested with or without the hand wheel. Some valve designs may require special operation of the hand wheel to engage with the valve operating mechanism, for example valves with hand wheels that incorporate a push to turn locking mechanism. With such valves it is permissible to override this mechanism during the endurance test.

10.6.1.4 For valves equipped with actuators, the test shall be conducted using the manufacturer's recommended parameters, for example, actuation pressure, voltage supplies.

10.6.1.5 For valves actuated with a lever the test shall be carried out by opening the lever through its full travel from closed to open.

10.6.1.6 Quick release valves designed for multiple actuations shall be tested for number of cycles and as per test parameters specified in the drawing.

10.6.1.7 For valves which are closed by torque, endurance test shall meet the requirement given in **10.6.2**. For other type of valves the test shall be carried out manually.

10.6.1.8 T_e and the leakage (by pressure drop) shall be established immediately before commencing every cycle. In case the pressure drop due to the valve leaking externally is greater than 10 bar, the valve has failed the test.

10.6.1.9 For some valve designs as given in Table 2, it is permitted to increase T_e during the test when the valve internal tightness is no longer achieved. For those designs if the pressure measured at the high pressure transducer (key no. 4 of Fig. 14) after having vented the outlet is more than 5 bar, T_e shall be increased by nominal 10 percent of allowed torque range between T_e and $T_{e,\,end}$ or 0.5 Nm (whichever is higher value) but in any case shall not be higher than $T_{e,\,end}$.

10.6.1.10 There shall be a pause between 3 s to 12 s at each open and fully closed position. The manufacturer may specify a pause within this allowed range.

10.6.1.11 After completion of 2 000 cycles, test samples will be tested for leak tightness test (*see* **10.5**) at room temperature, −20 °C and 65 °C at specified pressures given in Table 4 and maximum allowed $T_{e,\,end}$ shall not be exceeded (as per Table 2).

10.6.1.12 For all subsequent tests, maximum allowed $T_{e,\,end}$ according to Table 2 shall not be exceeded.

10.6.2 *Typical Arrangement of Endurance Test Equipment*

Fig. 14 shows typical arrangement of a computer controlled test machine.

10.6.2.1 *Requirements of machine and test cycle*

10.6.2.2 *Speed and application of torque*

The test machine shall be able to open and close the test sample at a speed of between ten and thirty rotations per minute.

At the end of the closing part of the test cycle, drift in torque due to dynamic effects shall be not more than 10 percent of the set value.

10.6.2.3 *Alignment*

The test sample and the test machine spindles shall be aligned in such a way that no significant side or axial load is put on the valve during the test. A suitable coupling may be used to accommodate misalignment.

10.6.2.4 *Verification*

Verification of the machine with regard to all test parameters to be controlled and measured, such as torque and pressure shall be carried out before commencing and after completion of each endurance test.

10.6.2.5 *Stroke of the endurance test*

The test sample shall be cycled through its full stroke except that the valve rotation shall be stopped 45° to 90° before the fully open position. This will ensure that the test machine does not apply torque in the fully open position. This shall not be applicable for ball valves in which case the ball valve will be turned from full close to full open position.

10.6.2.6 *Record*

The test cycle shall be recorded automatically (for example, as an illustration, *see* Fig. 15).

10.7 Visual Examinations

10.7.1 When the endurance test and the subsequent leak tightness tests have been completed, components, such as diaphragms, hand wheel and hand wheel to spindle interface, bellows and O-rings shall be subjected to a visual examination. No components shall be displaced (no longer in the place where it was installed) due to testing, non-functional (for example, broken) or missing.

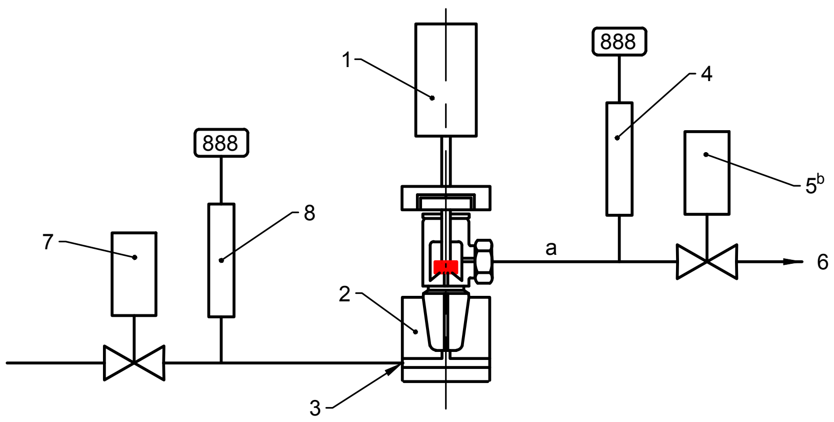
10.7.2 No sealing interface degradation such as tearing, ripping and particle accumulation (particle collected or produced at that point) shall be evident for metal to metal seated cylinder valves for oxygen service.

10.7.3 During the visual examination verification that the valve and its components correspond to the submitted set of the drawings shall be carried out.

10.8 Flame Impingement Test

10.8.1 This test shall only be carried on hand wheel/knob operated valves. One test sample shall be tested.

10.8.2 The valve operating device of the test sample in the open position shall be exposed for 60 s $^{+5}_{-0}$ to an LPG blowpipe flame of 150 mm length, such that the flame reaches a typical temperature of between 800 °C and 1 000 ° C. The valve operating device shall be completely enveloped by the flame.



KEY

1) D.C MOTOR WITH TORQE TRANSMITTER
2) TEST SAMPLE WITH ADAPTER
3) INPUT TEST MEDIUM
4) HIGH PRESSURE TRANSDUCER WITH DISPLAY
5) VENTING VALVE
6) OUTLET
7) VALVE
8) INLET HIGH PRESSURE TRANSDUCER WITH DIPLAY FOR MONITORING OF P_{vt}

a) IN CLOSED POSITION: FROM P_{vt} TO ATMOSPHERIC PRESSURE.IN OPEN POSITION P_{vt}
b) IN CLOSED POSITION: SEQUENCE CLOSED/OPEN/CLOSED.IN OPEN POSITION CLOSED

FIG. 14 TYPICAL ARRANGEMENT OF COMPUTER CONTROLLED TEST MACHINE FOR ENDURANCE TEST

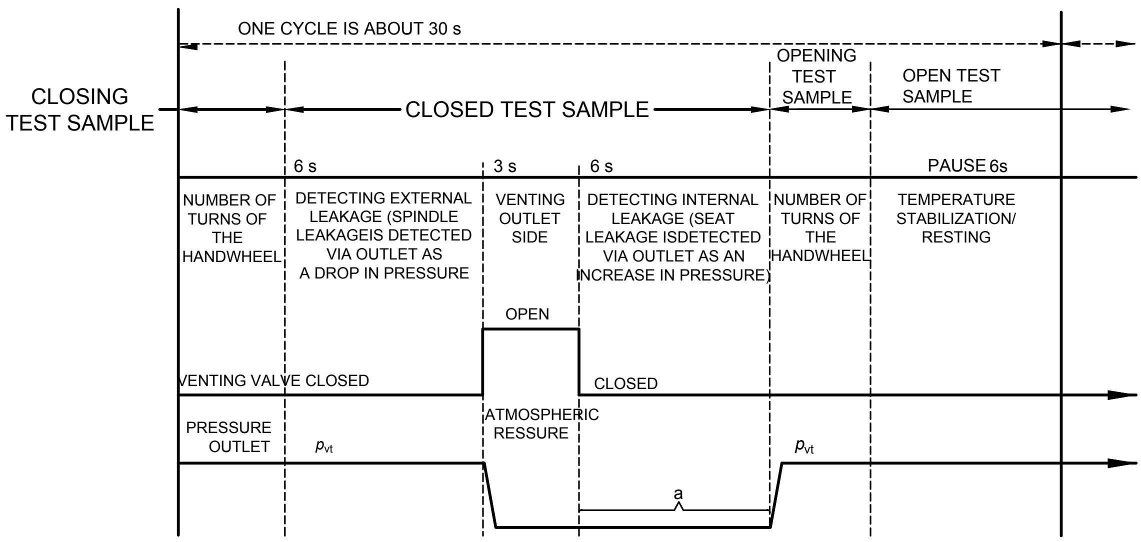


FIG. 15 DIAGRAM SHOWING A TYPICAL CYCLE FOR THE ENDURANCE TEST

10.8.3 Although the valve operating device may be damaged during the test, a manually operated valve shall still be possible to be closed by hand or using a simple tool after cooling.

NOTE — The temperature of the operating device exposed to the flame may be less than the temperature of the flame and need not be measured.

10.9 Flow Capacity of the Pressure Relief Device (PRD)

a) Three samples shall be tested to determine flow capacity of the PRD with the PRD installed on the valve. The purpose of the test is to measure the rated flow capacity of the pressure relief device (PRD). In case parallel safety is provided both the PRD's shall individually meet the minimum flow capacity requirement.
b) The manufacturer shall specify the maximum water capacity (W), subject to the minimum of 11 litres capacity for which the valve is designed. The measured flow capacity shall be equal to or greater than the minimum flow capacity calculated for the corresponding water capacity as per **7.1.6**.

10.9.1 *Procedure to Determine Flow Capacity*

a) The device shall be assembled from the inlet of the approach channel to the exit of the discharge channel in the manner normally assembled for use;
b) Each device shall be caused to operate either by pressure or temperature or by a combination of such effects and not exceeding either the maximum temperature or maximum pressure for which the device has been designed;
c) Without cleaning, removing parts, or reconditioning, each pressure relief device shall be subjected to an actual flow test wherein the amount of air released by the device is measured by flow measuring device;
d) Air or N_2 shall be supplied to the PRD through a supply pipe provided with a pressure gauge as close to the inlet of the valve as possible for recording the pressure;
e) The inlet pressure of the air or gas supplied to the safety device shall be 6 kgf/cm^2 gauge pressure;
f) Flow shall be recorded after steady flow conditions have been established; and
g) The rated flow capacity shall be the average flow capacity of devices tested, provided individual flow capacity falls within 10 percent of the highest flow capacity recorded.

NOTE — Ensure that there is no obstruction in flow line and the internal diameter for gas passage from the source cylinder to the valve inlet is greater than the largest orifice inside the flow passage of the valve from the valve inlet to the opening of the PRD.

10.10 Example of Test Sequence with Variants

Table 18 gives an example of test sequence for one valve design with three different O-ring material and two different non-metallic seat material, specifications as under.

10.10.1 The O-ring specifications are:

a) O_2 service - Ethylene propylene diene monomer (EPDM);
b) CH_4 service - fluorocarbon (FKM); and
c) N_2 service - nitrile butadiene rubber (NBR).

10.10.2 The non-metallic seal material specifications are:

a) O_2 service – Polyamide (PA); and
b) For gases other than O_2 service – Polyvinylidenefluoride (PVDF).

11 TYPE TEST (DESIGN QUALIFICATION) OF PRESSURE RELIEF DEVICE (PRD) USED WITH CNG VALVES

11.1 For the tests either the complete valve or the PRD removed from the valve may be tested unless specifically mentioned otherwise for example, vibration test (*see* **11.1.6**).

11.1.1 *Fusible Material – Resistance to Extrusion Test*

Three PRDs shall be tested with water at 30 MPa at room temperature for 30 min. The burst disc, where supported by fusible material shall not be removed. During the test the fusible material shall not begin to extrude out of PRD. Increase the pressure at a rate of 0.5 MPa/s to 60 MPa or to the pressure at which the fusible material starts to extrude. The extrusion of the fusible material shall not begin at a pressure lower than 45 MPa. For this test burst disc not supported by fusible material shall be removed before the start of the test and the port plugged.

11.1.2 *Accelerated Life Testing*

11.1.2.1 *General*

Fusible materials can creep and flow within the operating temperature range of natural gas vehicle PRDs.

Accelerated-life testing is performed to verify that the rate of creep is sufficiently low in order that the device can perform reliably for at least one year at 82 °C and for at least 20 years at 57 °C. Accelerated-life testing shall be performed on new PRD designs or designs in which the fusible material melt temperature or device activation mechanism is modified. For devices not using activation materials that can creep, testing and analysis shall be performed to verify that the device will perform reliably for at least one year at 82 °C and at least 20 years at 57 °C.

Table 18 Test Sequence for Type Testing (Basic Valve Design with Two Additional O-Ring Material and Two Different Non-Metallic Seal Material)

(*Clauses* 10.1.2 *and* 10.10)

Sl No.	Test Sequence as Per Table-3	Test and Relevant Clause	Total No of Sample To be Used	Test Sample Details with Respect To Variants
(1)	(2)	(3)	(4)	(5)
i)	1	Hydraulic burst pressure test, 10.4.1	a) 1	a) Sample with any O-ring and non-metallic seal material
ii)	2	Excessive torque test,10.4.4	b) 4	b) Samples with any O-ring and non-metallic seal material
iii)	3	Internal/external leak tightness at room temperature, 10.5	c) 6	c) Two samples each (one sample with first type of non-metallic seal material and the other sample with second type of non-metallic seal material) with three different O-ring materials.
iv)	4	Endurance test, 10.6		
v)	5	Internal/external leak tightness at room temperature, 10.5		
vi)	6	Internal/external leak tightness at low temperature, 10.5		
vii)	7	Internal/external leak tightness at high temperature, 10.5		
viii)	8	Visual examination, 10.7		
ix)	9	Flame impingement test, 10.8	d) 1	d) Sample with any O-ring and non-metallic seal material
x)	10	Flow capacity of the PRD, 10.9	e) 3	e) Samples with any O-ring and non-metallic seal material
xi)	11	Valve impact test, 10.4.2	f) One from each category	f) Sample(s) with any O-ring and non-metallic seal material
xii)	12	Valving torque test,10.4.3	g) One from each category	g) Sample(s) with any O-ring and non-metallic seal material

11.1.2.2 *Accelerated-life test temperature*

The accelerated-life test temperature, T_L, is given in °C by the expression:

$$T_L = 12.88.\ T_f^{0.420}$$

where

T_f is the manufacturer's specified activation temperature, in °C.

11.1.2.3 *Test procedure*

a) Place the test specimens in an oven or liquid bath, holding the specimen's temperature to within ± 1 °C throughout the test.

b) Elevate the pressure on the PRD inlet to 100 percent of the working pressure and hold this constant to within ± 0.7 MPa (7 bar) until activation. The pressure supply may be located outside the controlled temperature oven or bath. Limit volume of liquid or gas to prevent damage to the test apparatus upon activation and venting.

Each device may be pressurized individually or through a manifold system. If a manifold system is used, each pressure connection shall include a check valve to prevent pressure depletion of the system if one specimen fails.

11.1.2.4 *Requirements*

The test shall be performed on PRD design using fusible material for example for thermal activated relief devices and combination relief devices unless mentioned otherwise.

11.1.2.4.1 Two PRDs shall be tested at the fusible material yield temperature to verify that they activate in less than 10 h. This test is applicable only for combination relief devices.

11.1.2.4.2 Three PRD's shall be tested at their long term test temperature. The time to activation for long term test devices shall exceed 500 h.

11.1.3 *Continued Operation (Cyclic) Test*

Four PRD's shall be tested for continued operation with water or air maintaining minimum pressure ≤ 10 percent and maximum pressure ≥ 130 percent of the working pressure, at a maximum cyclic rate of 10 cycles per minute at a temperature as given in Table 19.

Table 19 Test Temperatures and Cycles

(*Clause* 11.1.3)

Sl No.	Temperature ± 2 °C	Cycles	Number of Test Samples
(1)	(2)	(3)	(4)
i)	82	2 000	2
ii)	57	18 000	2

Following the cyclic test there shall be no extrusion of the fusible material or failure of the burst disc.

At the completion of the test, the PRD shall comply with the requirements of Leakage test (*see* **11.1.7**) and Activation test (*see* **11.1.8**).

11.1.4 *Thermal Cyclic Test*

One PRD shall be thermally cycled between –20 °C and 82 °C as given below:

a) Place the depressurized PRD in a fluid bath maintained at –20 °C or lower for a period of 2 h or more. Then transfer the device to a fluid bath maintained at 82 °C or higher within 5 min; and
b) Leave the depressurized PRD in a fluid bath maintained at 82 °C or higher for a period of 2 h or more. Then transfer the device to the fluid bath maintained at –20 °C or lower within 5 min.

Repeat steps a) and b) until a total of 15 thermal cycles have been achieved. Cycle the PRD maintaining minimum pressure ≤ 10 percent and maximum pressure ≥ 100 percent of the working pressure for a total of 100 cycles.

At the completion of the test, PRD shall meet all the requirements of Leakage test (*see* **11.1.7**) and Activation test (*see* **11.1.8**).

11.1.5 *Condensate Corrosion Resistance Test*

Selected PRD shall be sealed from the outlet port. Fill the PRD with test solution given in **11.1.5.1** and soak the device for 100 h at room temperature. Empty the solution from the PRD and reseal the outlet port, then heat the device for an additional 100 h at 82 °C.

At the end of the test, PRD shall meet all the requirements of leakage test (*see* **11.1.7**) and Activation test (*see* **11.1.8**).

11.1.5.1 *Test solution*

The test solution, by volume percentage, consists of:

a) 84.8 percent stoddard solvent;
b) 10.0 percent benzene;
c) 2.5 percent fryquel no.15 or no. 20 compressor oil;
d) 1.5 percent water;
e) 1.0 percent methanol; and
f) 0.2 percent ethyl mercaptan (also known as ethanethiol).

11.1.6 *Vibration Test*

One valve sample shall be vibrated for 2 h in a test apparatus at 17 H_z with amplitude of 1.5 mm in each of the three directions (90° towards each other).

On completion of total 6 h of vibration, the valve shall comply with the requirements of leakage test (*see* **11.1.7**) and activation test (*see* **11.1.8**).

11.1.7 *Leakage Test at Low and High Temperature*

PRD's subjected to cyclic test (*see* **11.1.3**), thermal cyclic test (*see* **11.1.4**), Condensate corrosion resistance test (*see* **11.1.5**) and vibration test (*see* **11.1.6**) shall be tested for leakage at following temperatures and pressures as given in Table 20.

Table 20 Test Temperatures and Pressures

(*Clause* 11.1.7)

Sl No.	Temperature °C	Pressure
(1)	(2)	(3)
i)	–20	0.75 × WP
ii)	82	1.3 × WP

The PRD shall have a leakage rate less than 6 cm^3/hr which is approximately 4 bubbles of 3.5 mm diameter per minute.

11.1.8 *Activation Test*

11.1.8.1 *General*

The purpose of this test is to demonstrate that a PRD will activate consistently throughout its life.

11.1.8.1.1 Test one PRD without subjecting it to other tests in order to establish a baseline for activation.

11.1.8.1.2 Thermally activated relief devices shall be tested in accordance with **11.1.8.2**. Combination relief devices activated by a combination of high pressure and temperatures acting together, shall be tested in accordance with **11.1.8.3**. Pressure activated relief devices that is, burst disc not supported by fusible material shall be tested in accordance with **11.1.8.4**.

11.1.8.2 *Thermally activated relief devices*

11.1.8.2.1 *Test setup*

The test set up shall consist of an oven capable of maintaining temperature at 600 °C ± 10 °C inside the oven. The PRD shall not be exposed directly to the flame.

11.1.8.2.2 *Test procedure*

Pressurize the PRD to 25 percent of working pressure. Insert the PRD in the oven and record the time of activation, *t*.

11.1.8.2.3 *Requirement*

The PRDs subjected to cyclic test (*see* **11.1.3**), Thermal cyclic test (*see* **11.1.4**), condensate corrosion resistance test (*see* **11.1.5**) and vibration test (*see* **11.1.6**) shall activate to meet the following requirements:

$$\leq t + 4 \text{ min}$$

where

t = in minutes, is the time-to activation of the PRD not subjected to those tests.

11.1.8.3 *Combination relief devices*

11.1.8.3.1 *Test procedure*

Place the PRD in an oven heated to a temperature 10 °C above the yield temperature of the fusible material. Activate the PRD by pressurizing until the rupture disc bursts and record the pressure of activation.

11.1.8.3.2 *Requirement*

The PRDs subjected to cyclic test (**11.1.3**), thermal cyclic test (**11.1.4**), condensate corrosion resistance test (**11.1.5**) and vibration test (**11.1.6**) shall activate at a pressure >75 percent and <105 percent of the activation pressure of a PRD not subjected to any previous testing.

11.1.8.4 *Pressure activated relief device*

Test Setup: Test the bursting pressure of the bursting disc at room temperature.

11.1.8.4.1 *Test procedure*

Test Procedure:

Activate the PRD at room temperature by hydraulically pressurizing until the rupture disc bursts and record the pressure of activation.

11.1.8.4.2 *Requirement*

The PRD subjected to cyclic test (**11.1.3**), thermal cyclic test (**11.1.4**), condensate corrosion resistance test (**11.1.5**) and vibration test (**11.1.6**) shall activate at a pressure >75 percent and <105 percent of the activation pressure of a PRD not subjected to any previous testing.

12 TYPE TEST FOR EXCESS FLOW VALVE FOR CNG VALVES

12.1 Excess flow valve shall be tested hydraulically at pressure 2.5 times of working pressure.

12.2 The excess flow valve shall cut-off at pressure difference over the valve of 0.65 MPa maximum or as per customer requirement (not exceeding 0.65 MPa).

12.3 The residual leak of the excess flow Valve when activated shall not exceed 0.05 Nm^3/min at differential pressure of 10 MPa.

12.4 Excess flow valve shall be cycled 20 times at 20 MPa at differential pressure. One cycle consist of one opening and one closing. Upon the completion of test, excess flow valve shall comply with **12.2** and **12.3**.

13 PRODUCTION INSPECTION AND TESTING

13.1 Tensile Strength and Elongation Test

Samples from each batch of valve bodies as per Table 21 (scale of sampling) shall be subjected to the test for tensile and elongation of the material of the valve body for meeting the requirements as per **5.3.1** and the batch shall be declared satisfactory with respect to the requirement of tensile and elongation test if each sample passes the test satisfactorily.

Table 21 Scale of Sampling

(*Clauses* 5.4, 13.1, 13.2 *and* 13.4.7)

Sl No.	Batch Size	Sample Size
(1)	(2)	(3)
i)	Up to 500	2
ii)	501 up to 1 000	4
iii)	1 001 up to 2 000	6
iv)	2 001 to 3 000	8

NOTE — An allowance of a maximum of 2 percent in the lot size is permissible

13.2 Izod Impact Test

Samples from each batch of valve bodies as per Table 21 (Scale of Sampling) shall be subjected to the impact test (izod impact strength) for meeting the requirements as per **5.3.2** and the batch shall be declared satisfactory with respect to the requirement of izod impact test if each sample passes the test satisfactorily.

13.3 Internal and External Tightness Test

All valves shall be subjected to both internal leak tightness and external leak tightness at room temperature at working pressure (P_w). Valves shall be closed at T_c specified by the manufacturer but not exceeding $T_{e,\ start}$. For internal leak tightness the valve shall be pressurized from the valve inlet gas passage. For external leak tightness the valve in open position shall be pressurized from the valve inlet gas passage with the valve outlet connection sealed or pressurized from the valve outlet connection with the valve inlet connection sealed. The leakage shall be checked by a suitable method (e.g. bubble method, helium testing, fluid displacement measurement device, pressure change using differential pressure transducer or equivalent) and not exceed 6 cm^3/h.

For valves equipped with pressure relief device, testing shall be done at 0.8 times the minimum rated burst pressure of pressure relief device.

13.4 Tests for Pressure Relief Device (PRD)

13.4.1 Samples shall be randomly selected as per scale of sampling given in Table 22.

Table 22 Scale of Sampling

(*Clause* 13.4.1)

Sl No.	Batch Size	Sample Size
(1)	(2)	(3)
i)	From 3 to 8	2
ii)	From 9 to 15	3
iii)	From 16 to 30	4
iv)	From 31 to 100	6
v)	From 101 to 250	8
vi)	From 251 to 1 000	10
vii)	From 1 001 to 3 000	15

13.4.2 Valves equipped with bursting disc shall be checked for bursting pressure at room temperature as per IS 5903.

13.4.3 Valves equipped with fusible plug shall be checked for yield temperature of the fusible metal as per IS 5903.

13.4.4 *Valves Equipped with Combination Relief Device*

Burst disc and fusible plug shall be tested separately as per **13.4.2** and **13.4.3** respectively.

13.4.5 *Checking of Inlet Connection*

Samples from each batch of valves as per the scale of sampling given in Table 23 will be checked for inlet dimension. The threads shall be checked by calibrated ring gauges.

Table 23 Scale of Sampling

(*Clauses* 13.4.5 *and* 13.4.6)

Sl No	Batch size	Sample size
(1)	(2)	(3)
i)	Up to 500	10
ii)	501 up to 1 000	15
iii)	1 001 up to 2 000	20
iv)	2 001 to 3 000	25

13.4.6 *Checking of Outlet Connection*

Samples from each batch of valves as per the scale of sampling given in Table 23 will be checked for outlet dimensions. The threads shall be checked by calibrated gauges and other dimensions by vernier caliper or suitable measuring device.

13.4.7 *Checking of Other Dimensions*

Samples from each batch of valves as per scale of sampling given in Table 21 will be checked,for key operated valves, square of the spindle.

13.4.8 *Scale of Sampling*

13.4.8.1 Quantity of valve body blanks manufactured from same material and size manufactured under similar processes of production shall constitute a batch.

13.4.8.2 The number of valve bodies/valves to be selected at random from a batch shall depend upon the size of the batch and shall be in accordance with respective tables for identified inspection/tests.

13.4.8.3 The batch shall be declared satisfactory with respect to the requirement of the given test if each sample as per the scale of sampling passes the test satisfactorily. If any test sample, tested to tensile and elongation (**5.3.1**) and izod impact test (**5.3.2**), fails to meet the specified requirements therein, additional specimens equaling twice the number of sample size for the failed test in the same batch shall be taken and tested for the failed test only. If any of these specimens fails to meet the requirement, the entire batch represented shall be rejected.

14 MARKING

14.1 Cylinder valves complying with this standard shall be durably and legibly marked in service with:

a) Year and month of manufacture, that is, YYYY/MM;
b) Batch identification;
c) Manufacturer’s identification;
d) IS 3224;
e) Working pressure, MPa /bar;
f) Inlet code;
g) Outlet No.
h) Chemical symbol/name of the gas (optional)*;
j) The specified bursting pressure of the bursting disc (on the PRD, if provided), and

k) Yield temperature of the fusible plug (on the PRD, if provided);

m) Rated flow capacity and Set Pressure in MPa/bar on PRV or PRD as declared by the manufacturer; and

n) If the valve operated device closes the valve in anticlockwise direction, the closing direction shall be marked.

* If the chemical symbol/name of the gas is not punched on the valve then the chemical symbol/name shall be punched by the user when the valve is fitted to a cylinder.

14.2 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
319 : 2007	Free cutting brass bars, rods and section — Specification (*fifth revision*)
1068 : 1993	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium (*third revision*)
1598 : 1977	Method for izod impact test of metals (*first revision*)
1608 (Part 1) : 2018	Metallic materials — Tensile testing: Part 1 Method of test at room temperature (*fourth revision*)
2334 : 2001	ISO general purpose metric screw threads — Gauges and gauging (*second revision*)
2643 : 2005	Pipe threads where pressure-tight joint are not made on the threads — Dimensions, tolerances and designation (*third revision*)
5903 : 2014	Requirement of safety devices for gas cylinders — Specification (*first revision*)
6912 : 2005	Copper and copper alloy forging stock and forgings (*second revision*)
7202 : 2017	Inspection gauges for checking type iv (Size 1, 2, 3) taper threads of gas cylinder valves and cylinder necks — Specification (*first revision*)
7241 : 1981	Glossary of terms used in gas cylinder technology
8737 : 2017	Valve fittings for use with liquefied petroleum gas (LPG) cylinders for more than 5 litre water capacity — Specification (*second revision*)
8775 : 1978	Filling pressure and corresponding developed pressure for permanent gases contained in cylinders
9122 : 2008	Inspection gauges for checking Type 2 Taper thread of gas cylinder valves, taper 3 in 25 (*first revision*)
15894 : 2018	Inspection gauges for checking taper threads of gas cylinder valves and cylinder necks — Taper 1 in 16 on diameter — Specification (*first revision*)
15975 : 2020	Gas cylinders — Conditions for filling gas cylinders (*first revision*)
IS/ISO 11114-1 : 2012	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Metallic materials
IS/ISO 11114-2 : 2013	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Non-metallic materials

ANNEX B

(*Clause* 8)

THREAD CODE FOR INLET CONNECTION

Taper threaded inlet		
Code	Thread Designation	Inlet Type
08N	½ 14 NGT (1:16)	Type 1 (Size 1)
12N	¾ -14 NGT (1:16)	Type 1 (Size 2)
16N	1-11 ½ NGT (1:16)	Type 1 (Size 3)
12N1	¾ -14 NGT(CI) -1 (1:16)	Type 1 (Oversize 1)
12N2	¾ -14 NGT(CI)-2 (1:16)	Type 1 (Oversize 2)
12N3	¾ -14 NGT(CI)-3 (1:16)	Type 1 (Oversize 3)
12N4	¾ -14 NGT(CI)-4 (1:16)	Type 1 (Oversize 4)
1 7E	19.8 (3:25)	Type 2 (Size 1)
25E	28.8 (3:25)	Type 2 (Size 2)
18T	18.16 (1:8)	Type 4 (Size 1)
25.4	25.40 (1:8)	Type 4 (Size 2)
32T	31.75 (1:8)	Type 4 (Size 3)
18T-1	18.954 (1:8)	Type 4 Size 1 (Oversize 1)
18T-2	19.747 (1:8)	Type 4 Size 1 (Oversize 2)
18T-3	20.541 (1:8)	Type 4 Size 1 (Oversize 3)
18T-4	21.334 (1:8)	Type 4 Size 1 (Oversize 4)
25.4-1	26.194 (1:8)	Type 4 Size 2 (Oversize 1)
25.4-2	26.987 (1:8)	Type 4 Size 2 (Oversize 2)
25.4-3	27.781 (1:8)	Type 4 Size 2 (Oversize 3)
25.4-4	28.574 (1:8)	Type 4 Size 2 (Oversize 4)
32T-1	32.544 (1:8)	Type 4 Size 3 (Oversize 1)
32T-2	33.337 (1:8)	Type 4 Size 3 (Oversize 2)
32T-3	34.131 (1:8)	Type 4 Size 3 (Oversize 3)
32T-4	34.925 (1:8)	Type 4 Size 3 (Oversize 4)

Parallel Inlet Thread	
Code	Thread Designation
18P	M18 × 1.5 P-6g
25P	M25 × 2 P-6g
30P	M30 × 2 P-6g
U12	¾ -16 UNF — 2A
U18	1 ⅛ — 12 UNF-2A
SP12	¾ -14 NPSM

ANNEX C

(*Clause* 9.1.1)

THREAD CODE FOR OUTLET CONNECTION

Code	Outlet No.	Thread Designation	Type of Thread
G3/4A-LH	17	G3/4A-14 TPI-LH	BSP
G3/4A	20	G3/4A-14 TPI-RH	
G3/4	1	G3/4-14 TPI-RH	
G5/8A—LH	6	G5/8A-14 TPI-LH	
G5/8-LH	2 and 21	G5/8-14 TPI-LH	
G5/8A	5	G5/8A-14 TPI-RH	
G5/8	3	G5/8-14 TPI-RH	
G1/2A—LH	10	G1/2A-14 TPI-LH	
G1/2A	9 and 11	G1/2A-14 TPI-RH	
G3/8A-LH	14	G3/8A-19 TPI-LH	
G1/4A	15	G1/4A-19 TPI-RH	
G7/8A	19	G7/8A-14 TPI-RH	
EXT-W17	12	EXT-W17.42 × 1.27-RH	Whitworth
EXT-W21	7	EXT-W21.8 × 1.814-RH	
INT-12P	21a	INT-M12 × 1P-RH	Metric
EX1-22P	18	EX1-M22 × 1.5P-RH	

ANNEX D

(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinder Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	Shri M. K. Jhala (***Chairman***) Shri V. K. Mishra (*Alternate* I) Shri Jamunalal Rout (*Alternate* II)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku Shri K. R. Sahasranam (*Alternate*)
Ashok Leyland Limited, Chennai	Shri Ved Prakash Gautam Shri Faustino V. (*Alternate*) Shri Suchismita Chatterjee (*Young Professional*)
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Bhiwadi Cylinders Pvt Ltd, New Delhi	Shri Manvinder Singh Shri Rajneesh Chopra (*Alternate* I) Shri Sunil K. Dey (*Alternate* II)
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Kabsons Gas Equipments Ltd, Hyderabad	Shri Satish Kabra Shri S. Gopalaiah (*Alternate*)
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LPG Equipment Research Centre, Bangaluru	Shri K. K. Thakur Shri A. K. Bera (*Alternate*)
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Tekno Valves, Kolkata	Shri Y. K. Behani Shri Rohit Behani (*Alternate*)
The Automotive Research Association of India, Pune	Dr S. S. Thipse Shri S. D. Rairikar (*Alternate*)
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Vanaz Engineers Pvt Ltd, Pune	Shri S. J. Vispute Shri A. S. Latke (*Alternate*)
BIS Directorate General	Shri Rajneesh Khosla Singh, Scientist 'E' and Head (MED) [Representing Director General (*Ex-Officio*)]

Member Secretary
Shri Chandan Gupta
Scientist 'C' (MED), BIS

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Indian Oil Corporation Ltd, Mumbai	Shri Shankar Sharan Shri Sanjay Gupta (*Alternate*)

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